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Asbestos Fibers in Natural Runoff and Discharges from Sources Manufacturing Asbestos Products. Pt II-Non-Point Sources & Point Sources Manufacturing Asbestos Products

Walter C. McCrone Associates, Inc., Chicago, Illinois

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16. ABSTRACT

10 to the 12th power

The Office of Toxic Substances of the Environmental Protection Agency has sponsored a nationwide survey to determine the impact of point and non-point sources on levels of waterborne asbestos.

Part I of the final report presented the results of analyses of water from the ten Regional cities.

Part II of the final report, contained herein, presents the results of the analyses of water from natural sources and from point sources manufacturing asbestos products.

The results described indicate that waterborne levels of asbestos originating from natural sources may be as high as 10^8 fibers per liter and is subject to seasonal variation. Where asbestos was found, fibers were usually below 5 micrometers in length.

Levels of asbestos originating from asbestos product manufacture may range from below the detection limits of electron microscopy to values in excess of 10^{12} fibers per liter. Levels of asbestos fibers above 5 micrometers in length were found in excess of 10^{11} fibers per liter. The major impact on the environment due to such sources would be expected from asbestos paper plants which combine a high fiber content with a large effluent flow.

10 to the 8th power

10 to the 11th power

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ASBESTOS FIBERS IN NATURAL RUNOFF AND DISCHARGES FROM SOURCES MANUFACTURING ASBESTOS PRODUCTS

FINAL REPORT
PART II

October 1976

U.S. ENVIRONMENTAL PROTECTION AGENCY
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By

Ian M. Stewart
Richard E. Putscher
Howard J. Humecki
Richard J. Shimps

EPA Contract No. 68-01-2690

EPA Project Officer
Robert J. Carton, Ph.D.

For

Environmental Protection Agency

Office of Toxic Substances
4th and M Streets, S.W.
Washington, D.C. 20460

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NOTICE

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ASBESTOS FIBERS in NATURAL
RUNOFF and DISCHARGES from SOURCES
MANUFACTURING ASBESTOS PRODUCTS

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INTRODUCTION

The Office of Toxic Substances of the Environmental Protection Agency has sponsored a nation-wide survey to determine the impact of point and non-point sources on waterborne levels of asbestos. This survey covers natural sites, in which asbestos-bearing rocks are prevalent, and man-made sources. Additionally, it provides for sampling water supplies in a number of cites and towns. This report presents the results of analyses of water from natural sites in seven areas having potentially high background levels and five towns for which these natural sites are the water sources. Data are also presented for 22 plants manufacturing asbestos products and accounting for an estimated 40% of the total asbestos tonnage used in the United States. The range of products covered includes asbestos cement pipe and sheet, asbestos paper textiles and tiles. At twelve of these plants city water is used in processing: the results of analyses on samples of finished water for these cities are also included.

GENERAL CONSIDERATIONS

Natural Sites

The prime object in testing potential natural sites of waterborne asbestos was to establish ambient background levels. Depending on the rock formations through or over which the water is passing, and the extent to which these have been degraded by natural weathering processes, the natural background might be expected to vary from zero to a comparatively high asbestos fiber content. No figures were previously available to show how high this content might be in terms of fibers per liter, although some mass data, collected on the Connecticut River, is available.

In selecting natural sources we have assumed that the highest ambient background is the most important parameter to establish, as previous work, both in this laboratory and by other workers, had already shown that natural sites with no detectable asbestos do exist. It further seemed logical to identify for study, areas which would be largely free from industrial activity related to asbestos mining or processing and in which little or no asbestos usage was likely - that is, areas with a low population density. At the same time it was necessary to ensure a sufficient catchment area and satisfactory run off levels for the study to have meaningful results.

A detailed study was carried out to identify areas in which asbestos containing rocks might be expected to be exposed at or near the surface, of recorded occurrences of fibrous serpentine and amphibole, of river flow data and of active or recently active asbestos mining information. These data are summarized in figures 1 - 4 . When these several factors were considered simultaneously only five major areas of the country appeared as worthwhile candidates for study. These areas were the northern regions of Vermont and New Hampshire, southern Montana, the Washington-Oregon region, northern California and the boundary regions of Georgia, Carolina and Tennessee. From these regions three river systems were initially selected

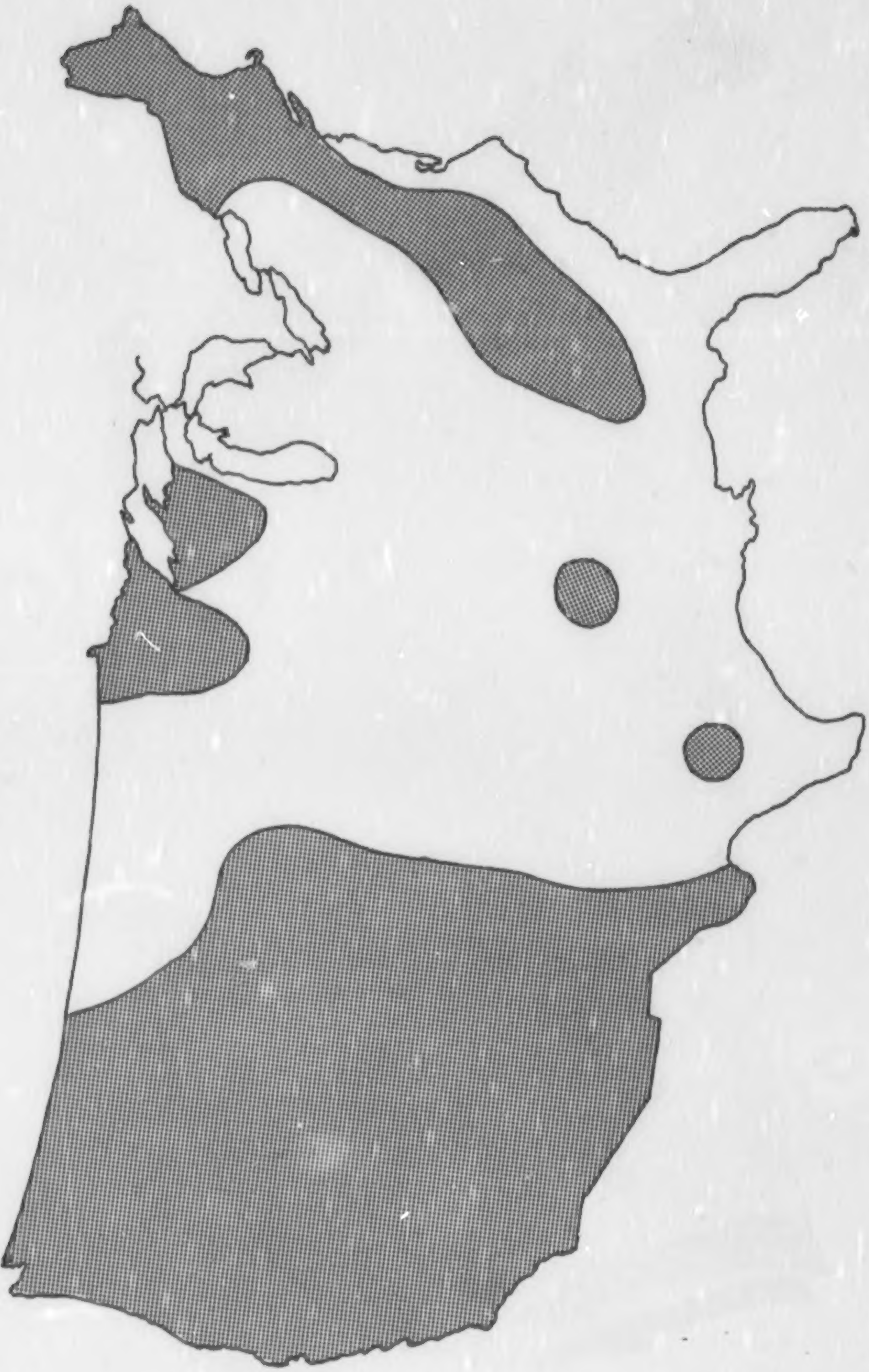


Fig 1. Areas of potential asbestos bearing rock types in the Continental U.S.

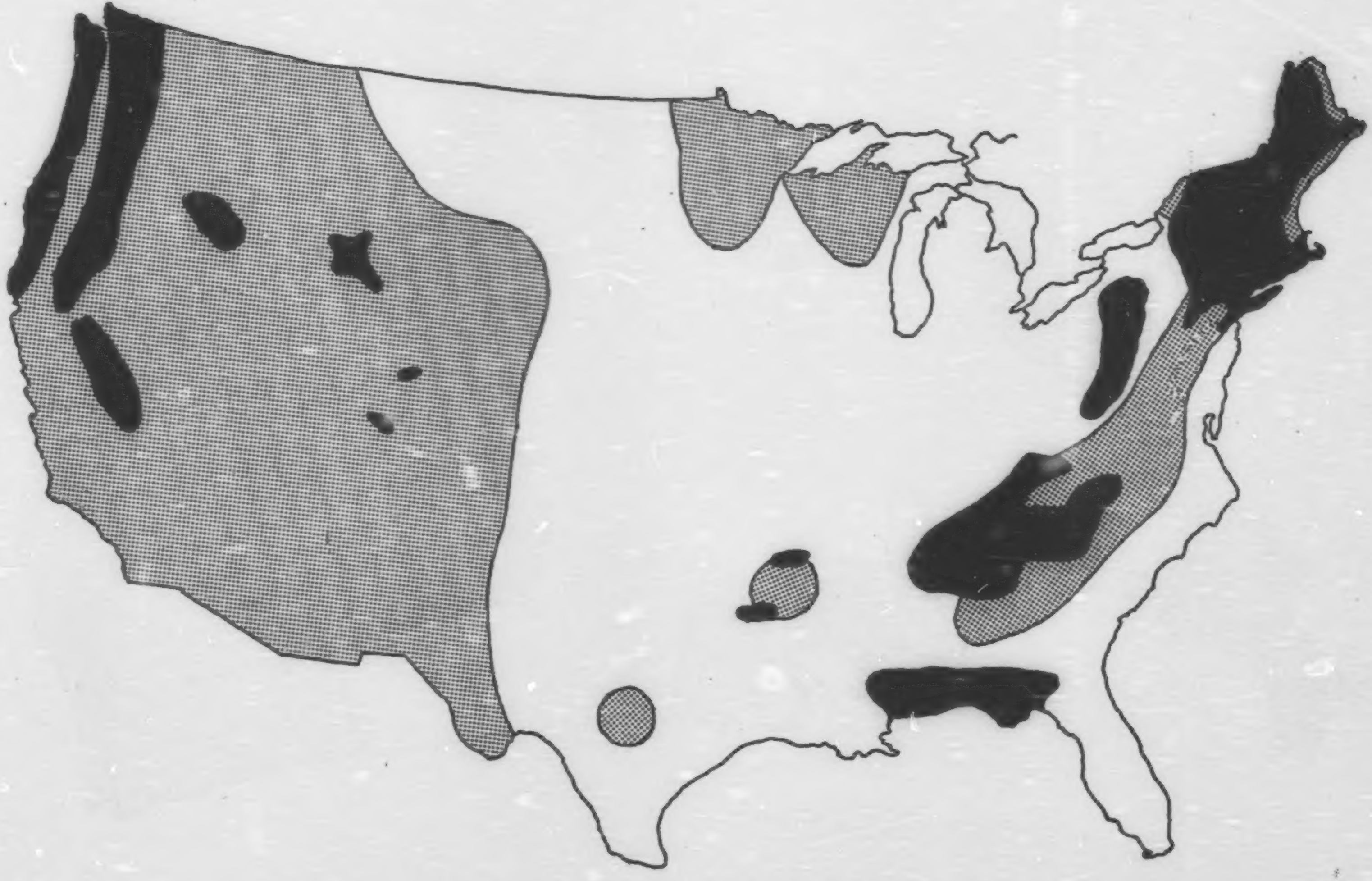
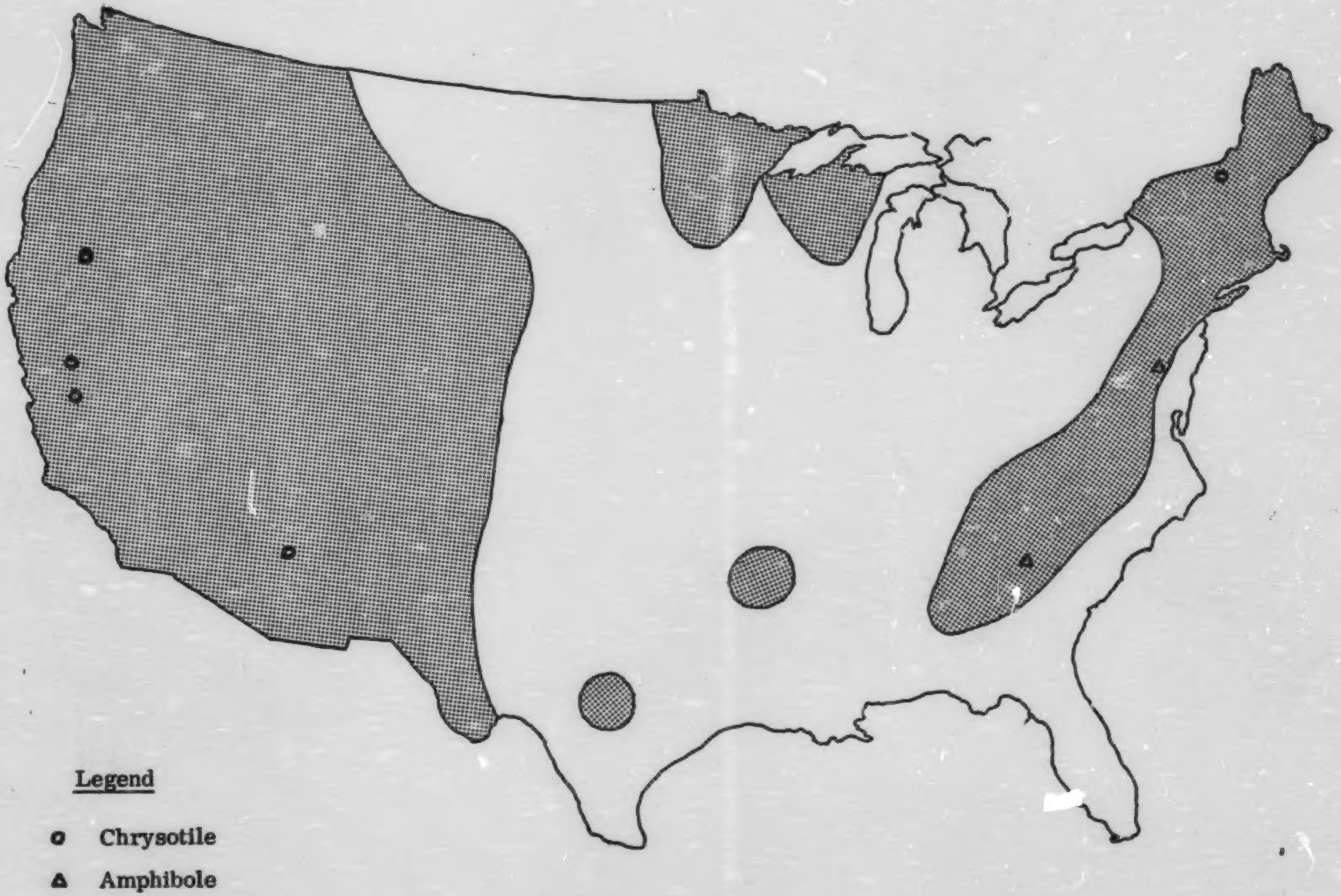


Fig 2. Relation between run off and areas of potential asbestos out-crops. Black areas average >20 inches run off per year.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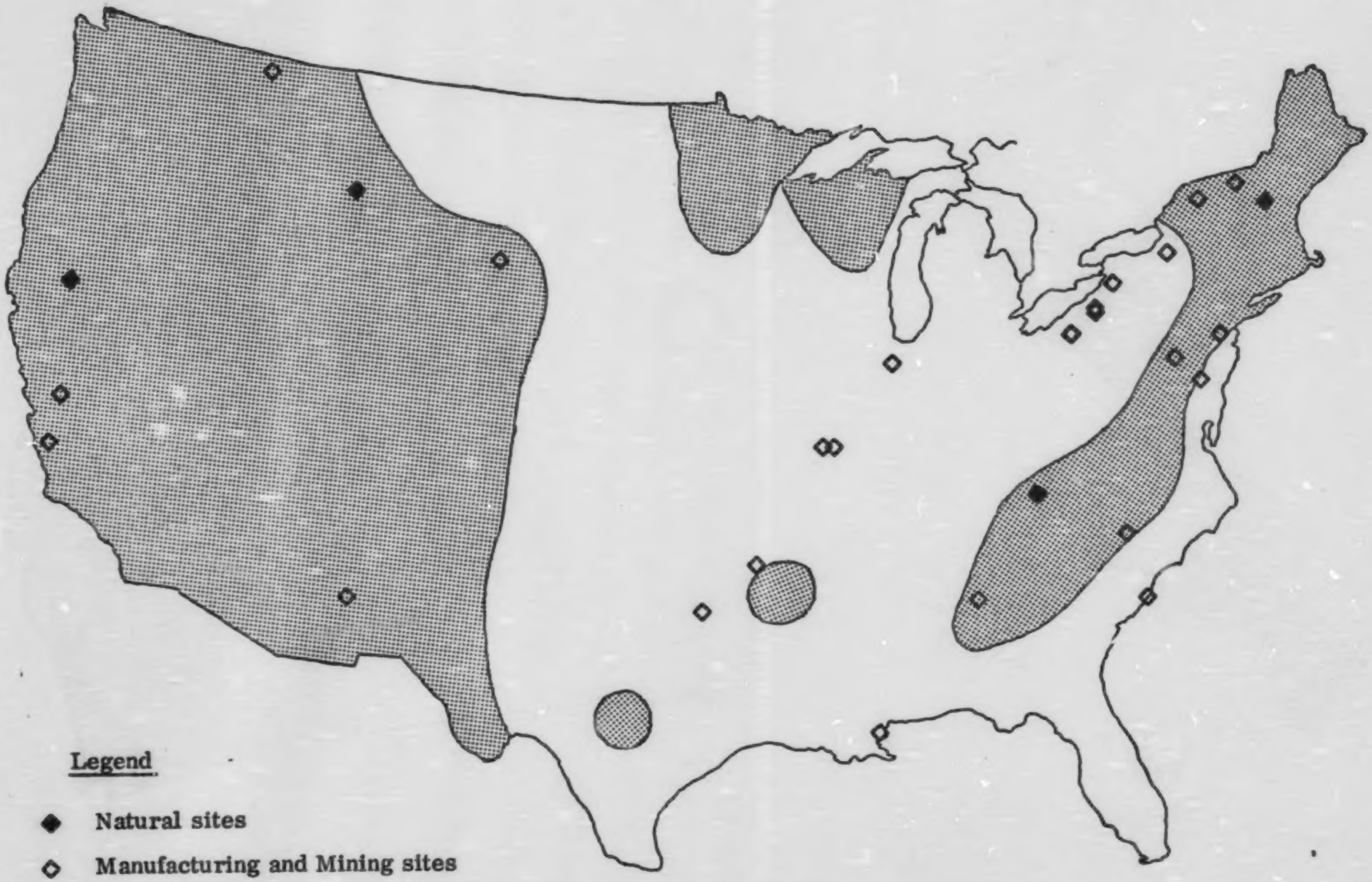
● Chrysotile
▲ Amphibole

Fig 3. Principal regions of active and recently active asbestos mining operations.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◆ Natural sites
◇ Manufacturing and Mining sites

Fig 4. Location of sampling sites

for study - the upper portion of the Connecticut River as it flows southwards along the Vermont-New Hampshire border, the upper reaches of the Red Rock and Beaverhead rivers in southern Montana and the upper portion of the Trinity River in Northern California. Following the request of the EPA project officer for additional natural sites to be sampled, portions of the Little Tennessee River, of the Hiwassee River and of the Chatooga-Savannah River systems, all located near the Georgia, Carolina and Tennessee borders were added. Additionally, while travelling between sampling sites it was possible to collect some samples from California reservoirs which had been suggested by Region IX personnel.

Two visits were made to each site to determine the effect of climatological changes on fiber levels. Rock fragmentation is highest during severe winter conditions thus releasing fibers. In the spring, water flow rates are high due to melting snows and at the same time erosion and transportation rates are highest when water flow rates are highest. The total potential fiber content of the water is thus highest in the spring. At the same time the higher water flow could equally have a dilution effect on the measured fiber content. By sampling at periods of higher and lower flow these hypotheses could be tested.

Manufacturing Sites

It is clearly impractical, from budgetary considerations, to sample every asbestos-using plant in the country. A representative sampling of plants was therefore made to cover as wide a range of product types and effluent treatments as feasible, and it is estimated that the plants sampled account for approximately 45% of the asbestos tonnage used in the United States. The major product types of asbestos cement pipe, asbestos cement sheet, asbestos paper and millboard, asbestos roofing and tile, asbestos textiles and friction materials are all represented. Effluent treatments varied from no treatment, through various settling and pH controls to total recycling.

In a few cases sedimentation treatment was only in the form of save alls which were periodically dumped, generally to a waste pile. Only 2 of the plants visited indicated that flocculent agents were used to assist sedimentation — the Johns-Manville paper plant at Tilton, N.H., and the National Gypsum AC sheet plant in New Orleans, LA.

At the start of the program 6 of the plants had apparently no waste water treatment other than save alls where the prime function was the conservation of raw materials for recycling rather than the removal of solid wastes from the effluent. The overflow from these save alls was discharged with no further treatment. Samples were generally taken of the incoming process water, of the discharge before and after treatment, at intermediate stages of treatment where applicable, at the fence line and, in some instances, at some distance up and downstream of the plant.

During the sampling program progress was seen in the industry's efforts to contain or minimize its effluents, with several of the plants visited making considerable progress towards total recycling, or "close up" of their process water, although in some instances the definition of "close up" apparently permits the intermittent discharge of clarifier overflows. Table I summarizes the water treatment facilities of the various plants visited.

TABLE 1

Plant	Type	Waste treatment	
		1st visit	2nd visit
Johns-Manville, Manville, NJ	general asbestos products	sedimentation, pH control	closed system tests being run
Johns-Manville, Denison, TX	pipe	sedimentation, pH control	closed system
CAPCO, Ragland, AL	pipe	sedimentation	closed system
CAPCO, Van Buren, AL	pipe	essentially closed	no second visit
Certain-Teed, St. Louis, MO	pipe	save alls only - periodically dumped to large waste pile	closed system with periodic discharge
Flintkote, Ravenna, OH	pipe	sedimentation, pH adjust, percolation	as on 1st visit
National Gypsum, New Orleans, LA	sheet	sedimentation w/flocculent, some recycling	similar to 1st visit but further progress in recycling
GAF, St. Louis, MO	sheet	save all overflow is pumped to waste pile, percolation w/no identifiable run off	as on 1st visit
Nicolet, Ambler, PA	sheet	sedimentation	as on 1st visit
Johns-Manville, Nashua, NH	sheet	sedimentation	as on 1st visit

Johns-Manville, N. Billerica, MA	sheet	closed system	no second visit
Johns-Manville, Tilton, NH	paper	sedimentation w/flocculent	as on first visit
Johns-Manville, Pittsburg, CA	paper & sheet	save alls only, overflow to sewer	as on first visit
Armstrong Cork Co. Fulton, NY	paper	sedimentation	as on first visit
GAF, Erie, PA	paper & mill-board	sedimentation	as on first visit
GAF, Whitehall, PA	paper & flooring	sedimentation	as on first visit
Hollingsworth and Vose, E. Walpole, MA.	paper	Walpole sewer system then Boston Met. Dist. Sewage	as on first visit
GAF, Erie, PA	roofing	closed system w/no discharge	no second visit
Armstrong Cork Co. Kankakee, IL	tile	descumming tank to remove oil residues	no second visit
Raybestos-Manhattan, Stratford, CT	friction materials	sedimentation	as on first visit
Raybestos-Manhattan, N. Charleston, SC	textiles	see individual descriptions in Appendix BB - various water lines	as on first visit
Raybestos-Manhattan Marshville, NC	asbestos products	sanitary sewer	no second visit

Most plants were visited twice, except where noted in the individual plant descriptions. In general, each visit was for at least two days, again with some exceptions, in order that sampling represent the full range of operations.

City Water Supplies

Finished water samples from 17 cities were obtained and analyzed for asbestos. Five of these, associated with potential natural asbestos sources, are Weaverville, CA; Redding, CA; Anderson, SC; Greenville, SC; and Chattanooga, TN. The remaining 12 are from a mining operation, and from plants where asbestos products are manufactured. They are Van Buren, AR; Pittsburg, CA; Stratford, CT; Kankakee, IL; New Orleans, LA; Billerica, MA; St. Louis, MO; Manville, NJ; Marshville, NC; Erie, PA; North Charleston, SC; and Lead, SD.

In addition to indicating asbestos levels in these 17 cities, the data provide baseline levels for those manufacturing plants using city water in their operation. Furthermore, since the water treatment varies from city-to-city, comparisons can be made of levels before and after treatment. These will be of value in determining the effectiveness of the treatment in reducing the asbestos level.

SAMPLING and ANALYSIS METHODS

The method of grab sampling was used throughout the program. Integrated samples obtained at the manufacturing sites were prepared by accumulating aliquots of individual grab samples taken during the period of integration. This method was preferred to automatic methods which generally involve comparatively narrow gauge tubing, valving systems and a "dead space" in their automatic collection chambers which it was felt might result in settling out of suspended solids. Additionally, the examination of grab samples gives some measure of the variability of the effluent resulting from variations in plant operations. AC pipe, for example, is manufactured essentially by a batch process, one pipe at a time being layed up on a mandrel, at the end of this cycle the excess process water is dumped from the machine to the save all resulting in a short duration high flow rate, followed by a low or zero flow as the next cycle is started.

Individual samples were filtered on site in a specially equipped mobile laboratory. Water used for rinsing glassware and diluting the samples where necessary was filtered distilled water, purchsed en route and filtered in the mobile laboratory using a filtration apparatus reserved solely for this water filtration. Aliquots of the samples were vacuum filtered through 47 mm diameter, 0.45μm pore size Millipore filters which were then stored in Petri slides for transportation back to the laboratory.

Segments of the filter samples were prepared for examination on the transmission electron microscope by a direct transfer condensation washing method. Nylon support grids were used to minimize spurious background signals during x-ray analysis in EMMA-IV, the combined electron microscope microanalyzer. Repeat samples were selected at random from the test series as a check on reproducibility.

In measuring the samples the criteria for a fiber to be measured and counted were that it should a) have an aspect-ratio greater than 3:1 and b) yield a diffraction pattern of chrysotile or an amphibole. In the event that an amphibole pattern was obtained an attempt was made to identify the amphibole type present on the basis of energy dispersive x-ray analysis.

The sample preparation method and the criteria for the identification of asbestos are substantially identical to those described in the interim procedure developed by EPA for asbestos determination.* It should be borne in mind that the application of these identification criteria will result in the omission of some asbestos fibers or in extreme cases, all, of the asbestos fibers from the count due to such factors as overlap, contamination, or, as is believed to have occurred in some AC systems, (e.g. CAPCO, Van Buren; National Gypsum, New Orleans and Johns-Manville, Nashua) encrustation with a cementation product which obscures clear diffraction patterns and modifies the apparent chemical composition. Sample counts under such conditions, therefore, can only be regarded as minimum estimates of the true asbestos fiber count and may be expected to show poorer reproducibility than those from laboratory prepared standards or "clean" systems.

Fibers counts resulting from less than 5 fibers observed must be treated with caution. In general, such numbers are of doubtful significance over possible background levels. In the laboratory situation near zero background may be achievable. In field sampling and filtration, however, background levels can reasonably be expected to be higher and may vary considerably from plant to plant, although no evidence of an increased background was detected from the blanks run under field conditions. To place in perspective this question of background, it should be noted that (1) background levels of 2 fibers per grid square have been reported by other workers, (2) this background level is equivalent to 2 fibers per 5 grid squares in the current work which uses nylon grids having a smaller grid opening and (3) when levels are recorded as "below the detection limit" this indicates that no fibers have been observed in an area encompassing

* available from Dr. Charles Anderson, SERL, EPA, Athens, GA.

at least 40 and occasionally as many as 120 grid squares. The occurrence of 5 fibers in such an area, therefore, would still be at least 1/3 lower than the accepted background of some other workers.

In many instances samples contained asbestos contents which were impossible to count because of the abundance of fibers present. These are indicated in the tables as "too numerous to count" (TNTC) and an estimated fiber content is given. This estimate is based on the equivalent fiber loading for 100 fibers observed in 1 grid square. Although dilution of the sample might seem a ready solution to this problem, many of the TNTC samples had already received extreme dilutions, with effective volumes sampled on the 47 mm dia filter as low as 0.2 ml. The problem of TNTC samples is illustrated in figs 5 and 6 in which an effective volume of 0.5 ml was filtered: the volume of sample represented by figure 6 is approximately 2.8×10^{-10} ml.

In addition to the TNTC samples some samples were physically too thick to allow penetration of the electron beam. These samples may or may not consist in whole or in part of asbestos. They are indicated in the tables as "too heavily loaded to count"(THL).

Captions

Fig. 5 T.N.T.C. Area of an electron microscope grid whose asbestos fiber loading is too high to count.

Vol. of sample filtered - 0.5 ml   Magnification 12,000X

Fig. 6 Same as Fig. 5   Magnification 30,000X

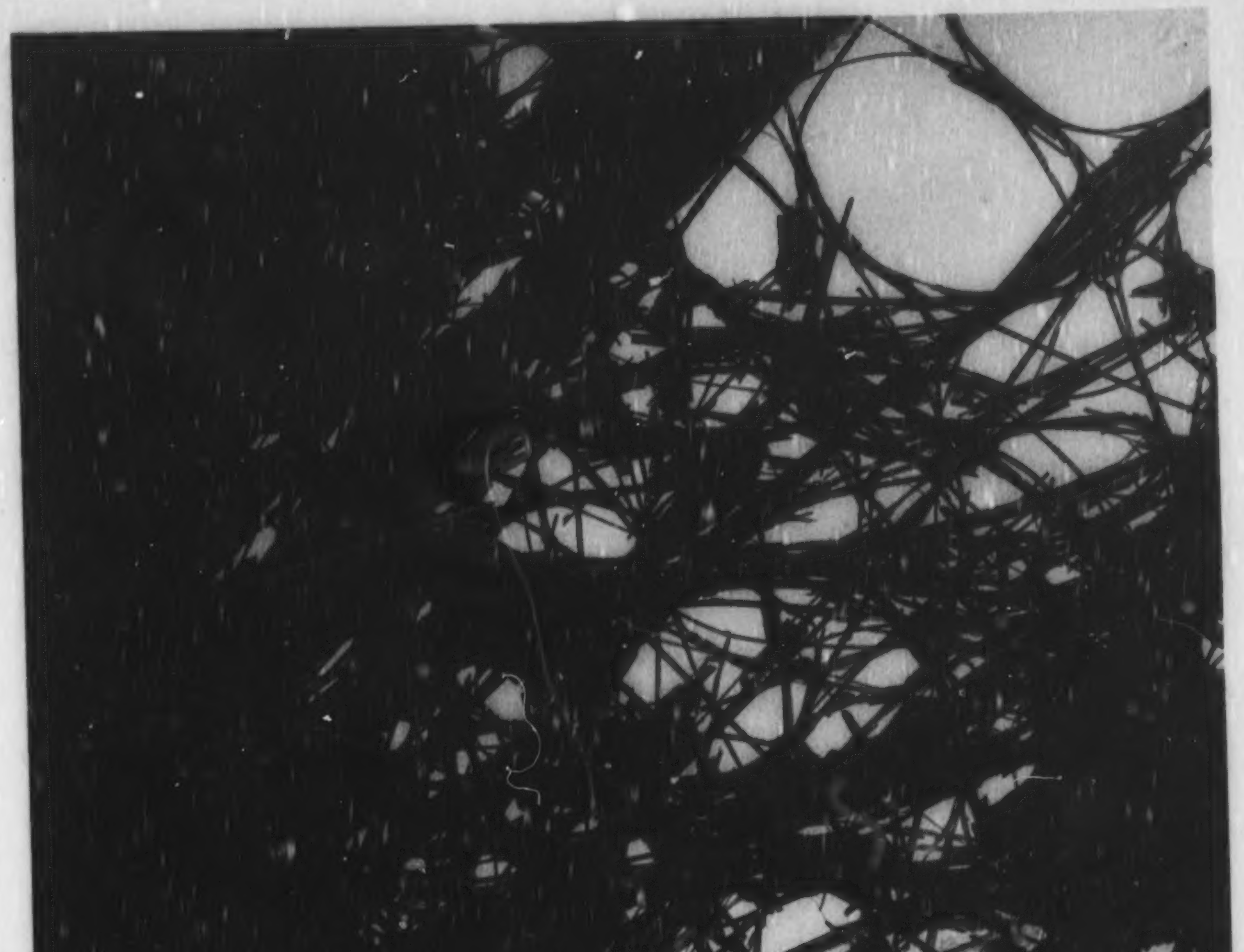

Fig. 5

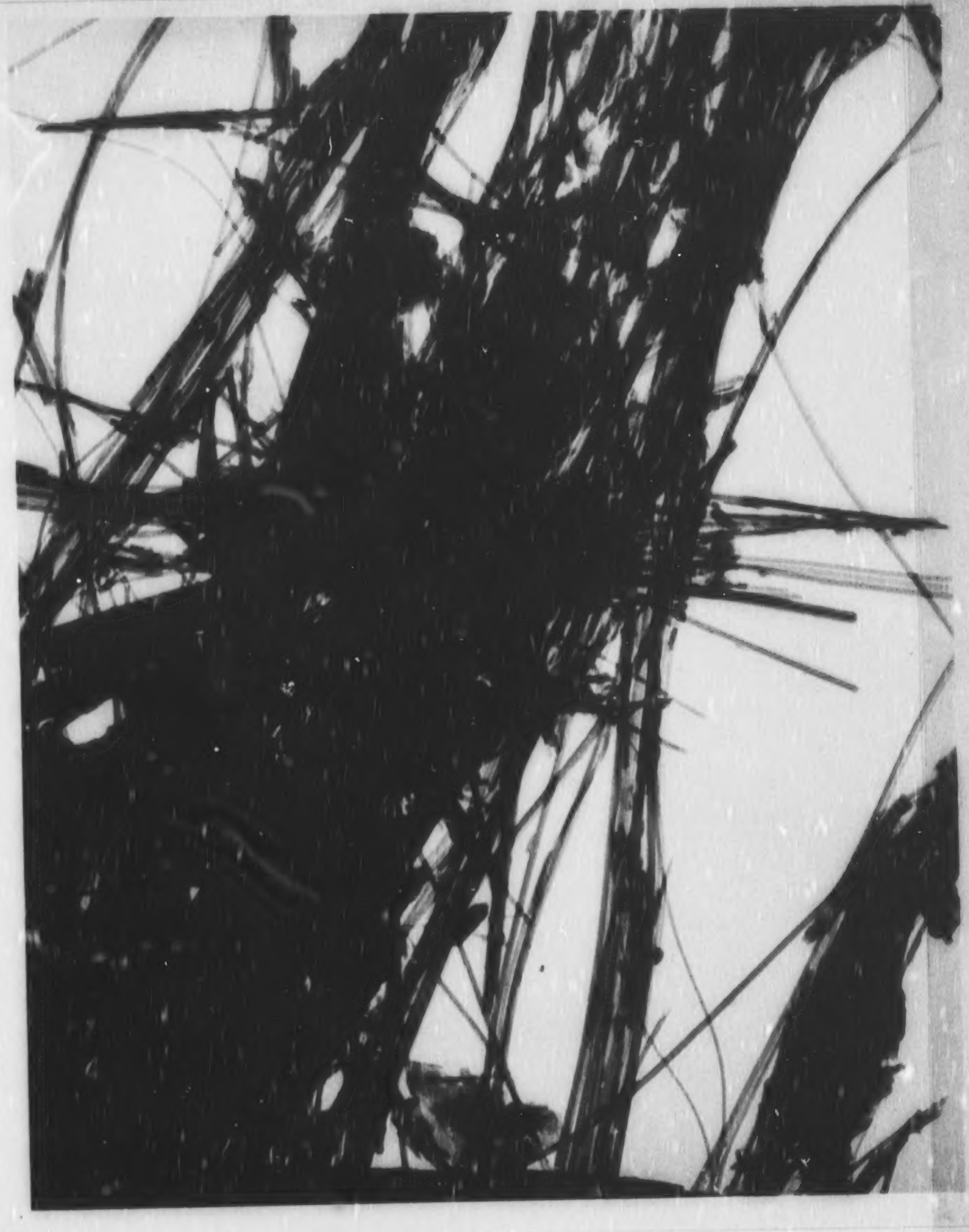

Fig. 6

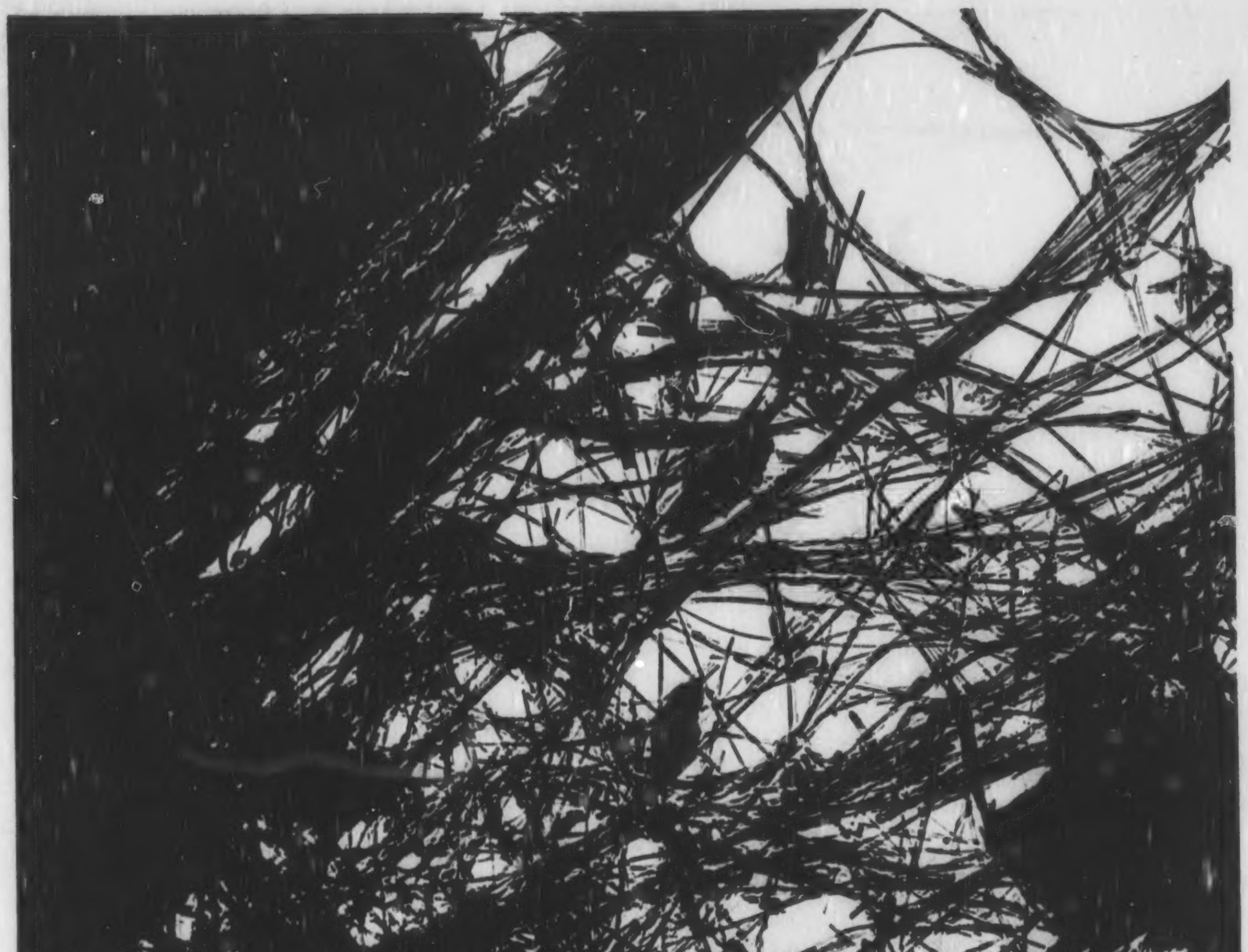

Fig. 5

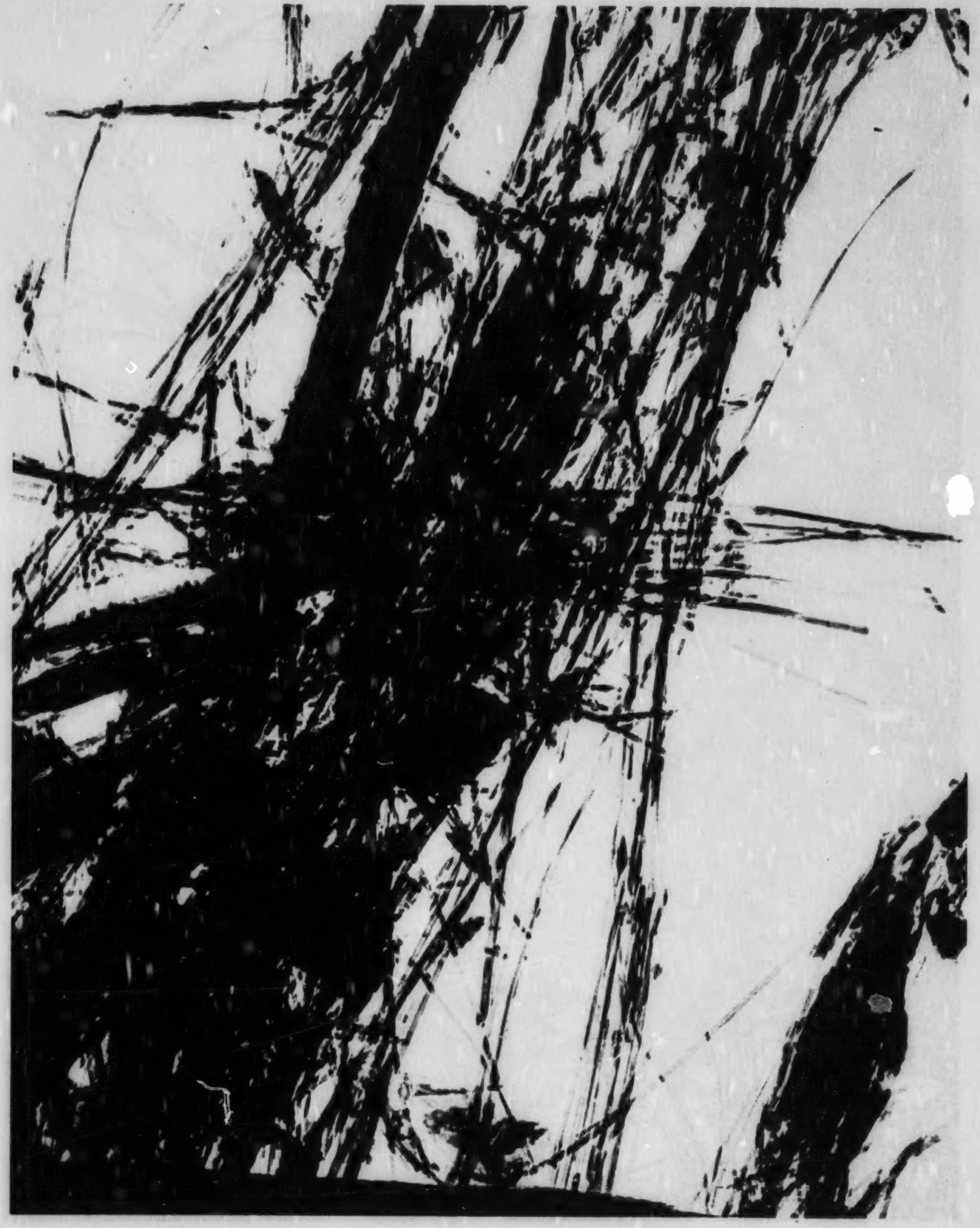

Fig. 6

RESULTS

Detailed descriptions of the sampling sites together with results of the analyses presented in tabular form are given in Appendices A - CC as follows:

Appendix	Site	Type	Site identification code
A.	Red Rock and Beaverhead Rivers, Montana	Natural	N1
B.	Trinity Valley, California	"	N2
C.	Various other California sites	"	N4, N5, N6
D.	Connecticut River, New Hampshire and Vermont	"	N3
E.	Tennessee, Georgia, Carolina border		N7, N8, N9
F.	Cities associated with Natural sites		
G.	Cities associated with manufacturing plants		
H.	Johns-Manville, Manville, NJ	Multi-products	G1
I.	Johns-Manville, Denison, TX	AC pipe	P1
J.	CAPCO, Ragland, AL	"	P2
K.	CAPCO, Van Buren, AR	"	P3
L.	Certain-Teed, St. Louis, MO	"	P4
M.	Flintkote, Ravenna, OH	"	P5
N.	National Gypsum, New Orleans, LA	AC sheet	S1
O.	GAF Corporation, St. Louis, MO	"	S2
P.	Johns-Manville, Nashua, NH	"	S3
Q.	Nicolet, Ambler, PA	"	S4
R.	Johns-Manville, Billerica, MA	"	S5
S.	Johns-Manville, Tilton, NH	Asbestos paper	R1
T.	Johns-Manville, Pittsburg, CA	"	R2
U.	Armstrong Cork Company, Fulton, NY	"	R3
V.	GAF Corporation, Erie, PA	"	R4
W.	GAF Corporation, Whitehall, PA	"	R5

X.	Hollingsworth and Vose, E. Walpole, MA	Asbestos paper	R6
Y.	GAF Corporation, Erie, PA	Roofing & tile	T1
Z.	Armstrong Cork Company, Kankakee, IL	"	T2
AA.	Raybestos-Manhattan, Stratford, CT	Textiles, friction materials	V1
BB.	Raybestos-Manhattan, N. Charleston, NC	"	V2
CC.	Raybestos-Manhattan, Marshville, NC	"	V3

Some brief discussion of the results for each site is included in the Appendix describing that site. The following general points can, however, be made.

Asbestos fibers have been found in natural sites in Montana, California and along the Connecticut River at levels as high as the mid to upper 10^7 fibers per liter range. The levels are greatly dependent upon seasonal variations and fibers are frequently undetectable at low flow conditions in locations where only a few months earlier, during high flow, measurable amounts were found. As might be expected, settling of the larger particles in lakes and reservoirs, where the currents are minimal reduces the mass of asbestiform minerals per unit volume. This, however, is not always reflected in the number of fibers per unit volume; a single large particle raises the mass per liter data significantly but has little effect on the number of fibers per liter. Table 2 summarizes the data from natural locations. It will be noted that few samples show any evidence of fibers $>5\mu m$ long and when these are present they represent only a small percentage of the total fiber count.

Samples from many of the sites in the Hiwassee River Valley in Georgia and North Carolina, the Little Tennessee River Valley in Georgia, North Carolina and Tennessee, and the Chatooga-Savannah River Valleys in Georgia and South Carolina contained no detectable asbestos.

Asbestos fibers were found in the finished water of several of the seventeen cities but the values reported are sometimes based on the presence of only 1 or 2 fibers and therefore cannot be regarded as statistically significant.

Of the industrial locations sampled, plants manufacturing asbestos paper present the greatest potential for contamination of surface water by asbestos. Not only are the fiber levels detected for final effluent highest for these plants, approaching 10^{10} - 10^{12} fibers per liter in some instances, but the total volume of water used is greater than other asbestos processes - of the order of 0.25 to 1.0 million gallons per day.

TABLE 2

Occurrence of asbestos fibers in natural locations

	Ave. fibers/liter		Ave. fpl > 5 µm		Flow (c.f.s.)*		
	High flow	Low flow	High flow	Low flow	Ave.	High	Low
Red Rock/Beaverhead (at Barretts) Montana	27(C)	BDL(0.87)	0	0	409	3720	69
Trinity R, California, at Big Bar	48(A)	4.4(A)	2.0(A)	+	2800	95000	80
					(interpolated values)		
L. Oroville, California (all samples close to detection limits)	1.7(A)	3.2(A)	0	0	not applicable		
Stanislaus River	BDL(2.0)	BDL(0.56)	0	0	not available		
Tullock Reservoir	9.4(C)	BDL(0.57)	0.7	0	not applicable		
	0.2(A)						
Connecticut River							
1) N. Stratford, NH	5.0(C)	BDL(0.84)	0	0	1549	28700	112
2) White River Jct.	6.2(C)	BDL(1.3)	1.7	0	7182	136000	115
3) Vernon	BDL(1.3)	BDL(1.0)	0	0	10720	17600	99

+ only deepest sample (2.5 ft) shows >5 µm. 3.8×10^6 fpl >5 µm out of total 9.3×10^6 fpl.

* Based on 86th Congress, 2nd session Committee Print No. 4 - "Surface Water Resources of the United States", U.S. Government Printing Office, Washington, D.C., 1960.

TABLE 2, con't.

Hiwassee River at Chatuge Lake	BDL	1.3(C)	0	0	not available		
Little Tennessee River	3.0	2.5	0.15	0	3000	2,000,000	35
					(approx interpolated values)		
Chatooga River	16	(0.4)	1.25	0	584	29000	88
Savannah River	BDL(0.4)	BDL(0.4)	0	0	4810	96500	492

Asbestos cement products manufacturing, although accounting for a substantial tonnage of raw asbestos fiber used, emits lower volumes of effluent and appears more amenable to separation of the suspended solids and/or recycling of the process water. Indeed, 4 of the 5 AC pipe plants visited were running with closed systems by the end of the sampling program.

Asbestos tile and textile manufacturing operations in which there is very limited asbestos-water contact show only low or undetectable levels of asbestos in their final effluents.

These generalizations may be summarized in tabular form as follows.

TABLE 3

Plant type	Range of asbestos level in final effluent
Asbestos cement pipe	$10^6 - 10^7$ f.p.l.
Asbestos cement sheet	$10^7 - 10^{10}$ f.p.l.
Asbestos paper	$10^8 - 10^{12}$ f.p.l.
Asbestos tile	$<10^6 - 10^7$ f.p.l.
Friction materials	$10^9 - 10^{10}$ f.p.l.
Asbestos textiles	$<10^6 - 10^7$ f.p.l.

In general, levels for fibers >5 μm in length are about an order of magnitude lower than total fiber levels, with the notable exceptions of the amosite fibers from the Johns-Manville plant at Billerica, and the effluent from Hollingsworth and Vose, E. Walpole, each of which have approximately 50% of their fibers >5 μm in length.

The impact of these levels on natural waterways is difficult to assess purely from the number observed. For example, the Denison AC pipe plant of Johns-Manville on the first sampling visit was discharging 75,000 gallons per day of effluent with a maximum level of 3.7×10^8 fibers per liter into the Red River which at that location has an average flow rate of 5845 cubic feet/sec or 3775.8 million gallons per day. Assuming a straight dilution took place, fiber levels downstream due to this Johns-Manville plant should be less than 2000 fibers per liter – below the limit of detection by electron microscopy. In other locations, however, where fiber levels are higher and a closer relationship holds between effluent and river flow rates asbestos fibers have been detected downstream of asbestos plants (figures 7 and 8) and at levels appreciably above the detection limits. For example, in the Raritan River 3 miles below Manville, NJ with an average flow rate of approximately 700 m.g.d. the asbestos fiber count is 10^8 - 10^9 f.p.l. In other rivers, notably the Oswego near Fulton, NY, the Nashua River, NH, and Wissahickon Creek, PA, high levels of asbestos fibers below an asbestos plant discharge have been accompanied by similarly high levels in the intake to that plant and it is not possible to say that the presence of the plant has resulted in a significant contribution to the asbestos content of the waterway.

In attempting to establish any effluent standard for asbestos plants, therefore, due cognizance must be taken of dilution or concentration effects within the plant, of the nature of the discharge, whether continuous, periodic or sporadic, and of the waterways at risk in order that a viable, and enforceable, figure may be derived. It is not the purpose of this current work to establish this standard, but rather to provide a data base from which such a standard may be derived.

Captions

Fig. 7 Asbestos fibers in the Raritan River 3 miles below asbestos plant outlet.

Magnification 12,000X

Fig. 8 Same as Fig. 7 Magnification 30,000X

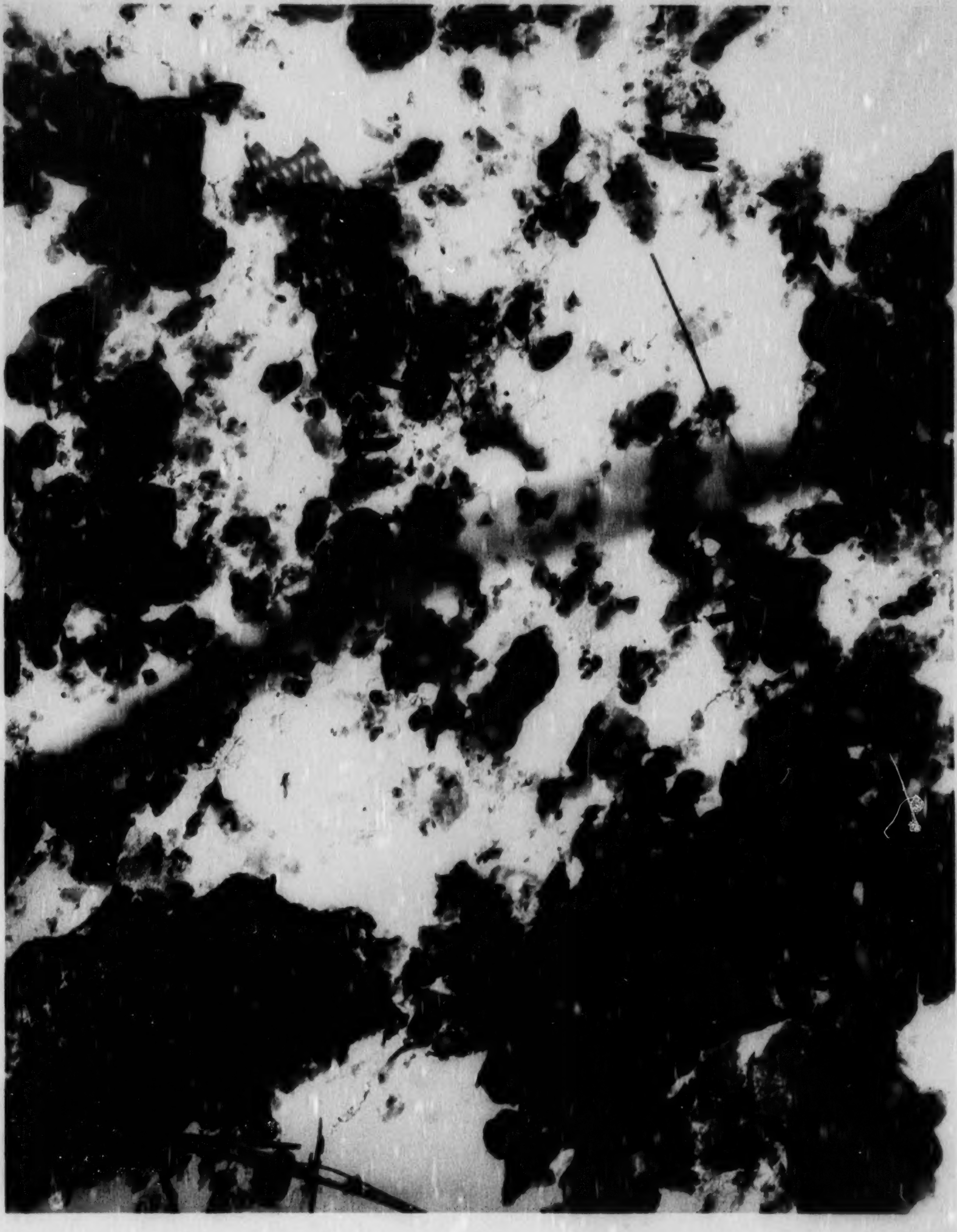

Fig. 7

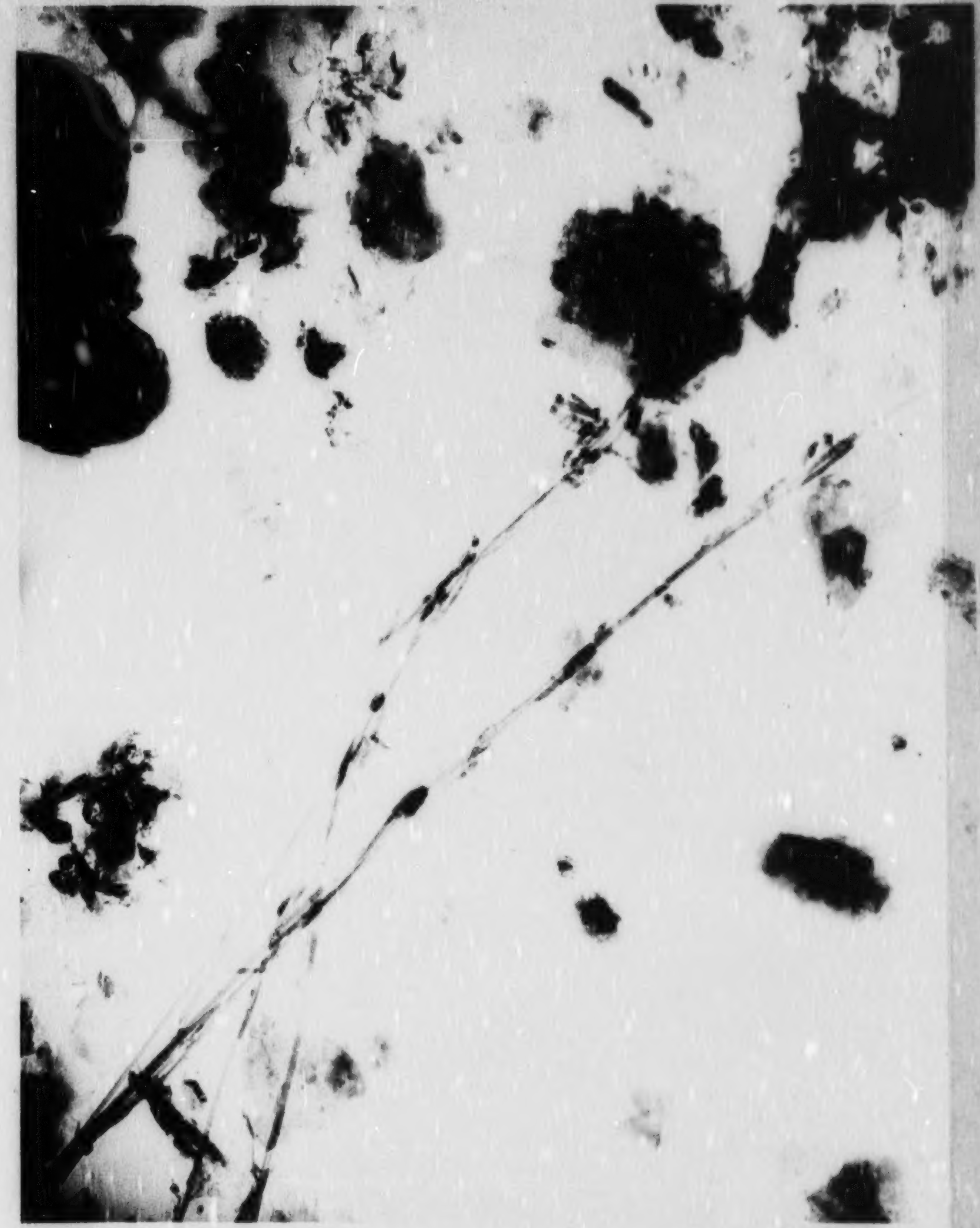

Fig. 8

Appendices A - CC

Table legend

Location = sampling point

Type = sample type;
  I = Integrated
  G = Grab
  (R) = Repeat analysis

fpl = fibers per litre x 10^6
  (A) = amphibole
  (C) = chrysotile
  BDL = below detection limit - detection limit given in parentheses
  TNTC = too numerous to count. The figure in the following column is an estimated lower limit based on a figure of 100 fibers per grid square
  THL = sample too heavily loaded for examination

>5µm = number of fibers >5µm long (fpl x 10^6)

tss = total suspended solids in mg/l

na = not available

Appendix A

Red Rock and Beaverhead Rivers, MT Code: N1

Red Rock River originates near the Montana-Idaho border east of the Red Rock Lake Wildlife Refuge. After flowing westward through the Upper and Lower Red Rock Lakes it narrows and then broadens as it develops into a reservoir under the constraint of the Lima Dam. In springtime run off from melting snows on the hills that surround it floods the valley making the raods impassable and turning the flatlands into a shallow lake. During the dry season the water drains from these areas although there is always sufficient run off to prevent the river bed from drying up. The distance from the Lima Dam to the Idaho border is approximately 50 miles.

Downstream of Lima the Red Rock turns northwest and then north, as it passes through Dell, Barretts Dam and finally Dillon. North of Dillon it is known as the Beaverhead River. The northernmost point sampled was at Twin Bridges which is about 120 miles north of Lima.

No mining activities have been reported in the described area east of Lima. Further downstream, after the river swings north and near the 45th parallel, talc mining activities are reported near the Madison-Beaverhead County boundary. Of these activities only the Smith -Dillon mine would affect the drainage basin of the Beaverhead River, the other apparently lying to the east of the watershed and in the drainage basin of the Black Tail Deer Creek. Any impact of these would be observed first at Dillon.

Sampling points were selected at Red Rock Creek before the waters enter the Upper Red Rock Lake, the Lima Reservoir, a branch of the Red Rock River just east of Lima, the Red Rock River at Dell, the Red Rock River at Barretts Dam, the Red Rock River at Dillon and the Beaverhead River at Twin Bridges. Figure A-1 shows these locations.

Samples were taken in early June 1975 when the run off was high, and again in late August 1975 during the dry season. The Lima Reservoir was

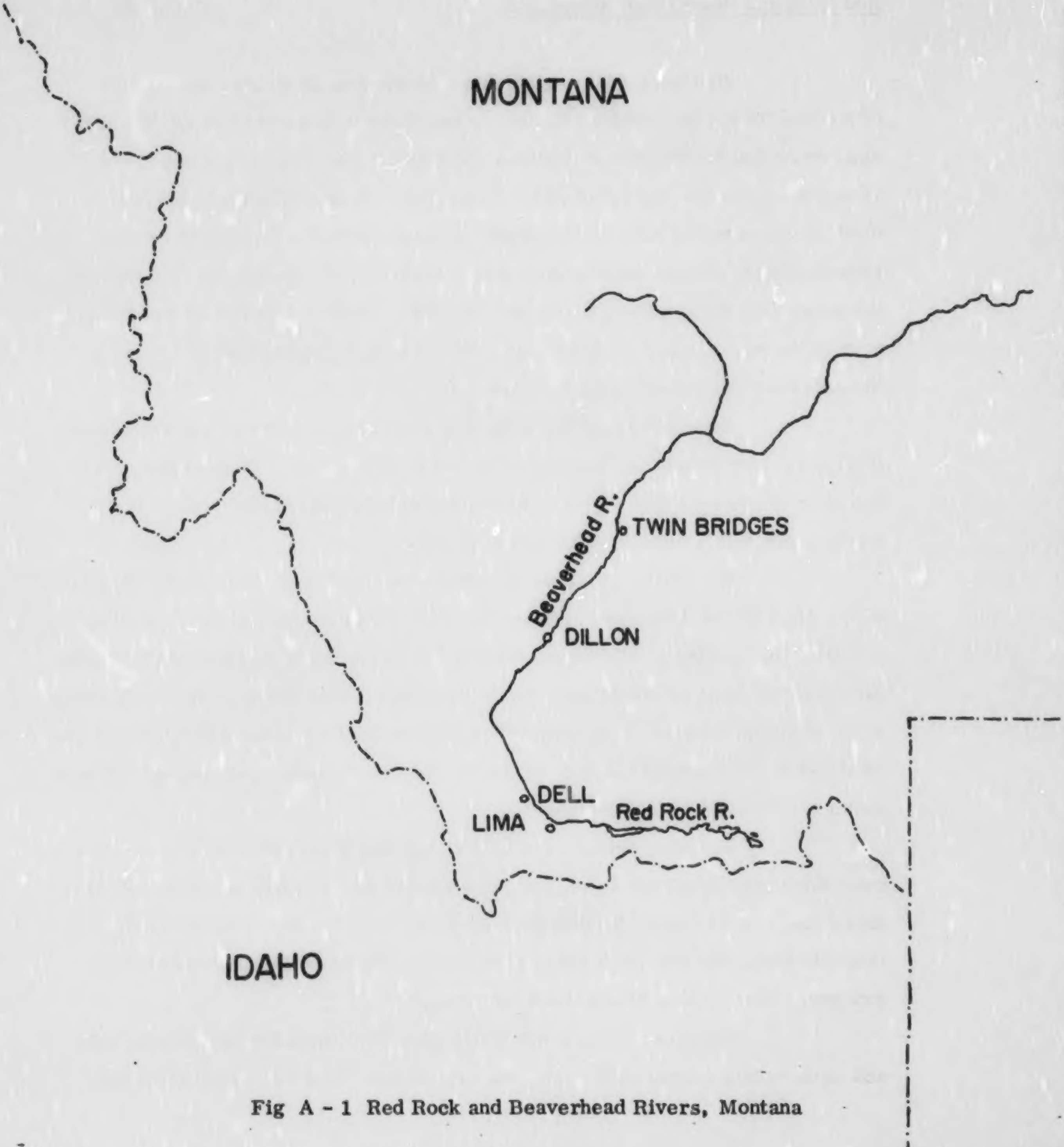
MONTANA
Beaverhead R.
TWIN BRIDGES
DILLON
DELL
LIMA
Red Rock R.
IDAHO

Fig A - 1 Red Rock and Beaverhead Rivers, Montana near its all-time high in June of 1975 and the low land from Lakeview to Lima was marshy. The rivers from Lima to Twin Bridges were swollen but not overflowing. During August 1975 the waters had diminished considerably, but were up slightly from normal due to the wetter-than-usual summer.

Montana

TABLE A-1

See Legend - page 29

		6/6/75					8/25/75				
Miles	Location	Depth	fpl	No. >5μm	tss mg/l	fibers counted	Depth	fpl	No. > 5μm	tss mg/l	fibers counted
0	Red Rock Creek nr Lakeview	surface	BDL(2.5)	-	115	0					
		1.5'	2.8(C)	0	120	1	2'	BDL(0.65)	-	3	0
		3.0'	BDL(4.2)	-	121	0	4'	BDL(0.68)	-	2	0
35	Lima Reservoir	surface	9.6(C)	0	17	6	0.5'	BDL(1.2)	-	21	0
		2.0'	BDL(1.35)	-	15	0	3.0'	BDL(0.64)	-	22	0
							3.0'(R)	4.5(C)	.64	22	7
							3.0'(R)	BDL(0.64)	-	22	0
		4.0'	BDL(1.4)	-	15	0	6.0'	1.3(C)	0	26	2
50	Red Rock Creek below Lima Res.	surface	44(C)	6.3	37	14	surface	BDL(1.3)	-	23	0
		* 3'	14(A)	0	41	4	2'	BDL(0.65)	-	22	0
		3'(R)	3.1(C)	0	41	2	4'	BDL(0.7)	-	30	0
		* 6'	56(A)	7	35	16					

* amphibole at 3' identified as crocidolite; at 6' low Fe Cummingtonite-grunerite or nigh Fe anthophyllite

Montana, page two

TABLE A-1 con't.

		6/6/75					8/25/75				
Miles	Location	Depth	fpl	No. >5μm	tss mg/l	fibers counted	Depth	fpl	No. > 5μm	tss mg/l	fibers counted
62	Red Rock Creek 1/2 mi North of Dell	surface	BDL(3.14)	-	73	0	0.5'	BDL(0.64)	-	12	0
		2'	BDL(5.7)	-	70	0	1.5'	BDL(0.7)	-	15	0
		4'	BDL(3.14)	-	64	0	3.0'	BDL(0.91)	-	16	0
89	Barretts at diversion dam	surface	28(C)	0	61	10	0.5'	BDL(1.3)	-	9	0
		** 0.5'	32(C)	0	58	9	1.5'	BDL(0.68)	-	9	0
		1.0'	22(C)	0	58	8	3.0'	BDL(0.63)	-	9	0
113	Beaverhead River at Dillon ***	surface	BDL(3.14)	-	74	0	0.5'	BDL(1.0)	-	14	0
		2.0'	18(C)	0	70	5	1.5'	3.4(C)	0	12,	3
		4.0'	43(C)	6.6	77	13	3.0'	BDL(0.98)	-	16	0

** all fibers < 0.5μm long

*** Any effect due to talc mining should appear here

Montana, page three

TABLE A-1 con't.

		6/6/75					8/25/75				
Miles	Location	Depth	fpl	No. >5μm	tss mg/l	fibers counted	Depth	fpl	No. > 5μm	tss mg/l	fibers counted
148	Beaverhead River at Twin Bridges	surface	BDL(5.7)	-	163	0	0.5'	BDL(0.78)	-	29	0
	***	surface(R)	140(C)	18.9	163	37	2.5'	BDL(1.4)	-	26	0
		3.0'	BDL(4.65)	-	149	0	5.0'	BDL(0.71)	-	29	0
		6.0'	BDL(5.03)	-	150	0					

*** chrysotile found in 2 small areas only

Appendix B

Trinity Valley, CA Code: N2

There are several rivers in California which could be a potential high background site, but to avoid high population densities, and at the same time have reasonable water flows, the northern end of the state was indicated. The upper reaches of the Trinity River fit the requirements of low population density, recorded asbestos exposures in the vicinity and no active mining for asbestos. Alternates which were considered were the Klamath River and the upper reaches of the Sacramento. The latter was rejected due to the possibility of interference by dumps from former asbestos mining activity. The Trinity was preferred to the Klamath because of reported asbestos occurrences near the head water of the Trinity. The Trinity flows south from its origin in mountainous terrain entering the northern end of Clair Engle Lake. At the southern end, Trinity Dam controls the flow into Lewiston Lake which is about 2-1/2 miles long. After passing over Lewiston Dam located at the southern end of the lake, the Trinity turns generally westward and eventually merges with the Klamath.

The Sacramento River parallels the Trinity as it flows south into Lake Shasta over Shasta Dam to Redding. The Sacramento continues south whereas the Trinity turns west.

Sampling points along the Trinity were selected at Coffee Creek north of Clair Engle Lake, at Trinity Dam, at Lewiston Dam, the Trinity at Big Bar and the Trinity at Cedar Flat. Weaverville city water was sampled as well as water from Weaver Creek - the source of Weaverville water, and a tributary of the Trinity.

The City of Redding finished water and raw water (from the Sacramento River) were also obtained.

Samples were obtained in early March 1975 and again in early September. The snow was melting in the Trinity region north of Clair Engle Lake in March, swelling the river to its uppermost banks throughout its course. In September the volume was reduced considerably.

Both chrysotile and amphibole fibers are detected in the Trinity River, frequently occurring simultaneously at levels exceeding 10^7 fibers per liter. The amphibole present is identified as a member of the Tremolite-Actinolite series with a moderately low Fe content. There is evidence that the tared filters taken on the second visit were not completely stabilized prior to the first weighing, resulting in unreliable total solids data for this visit. This data has therefore been discarded.

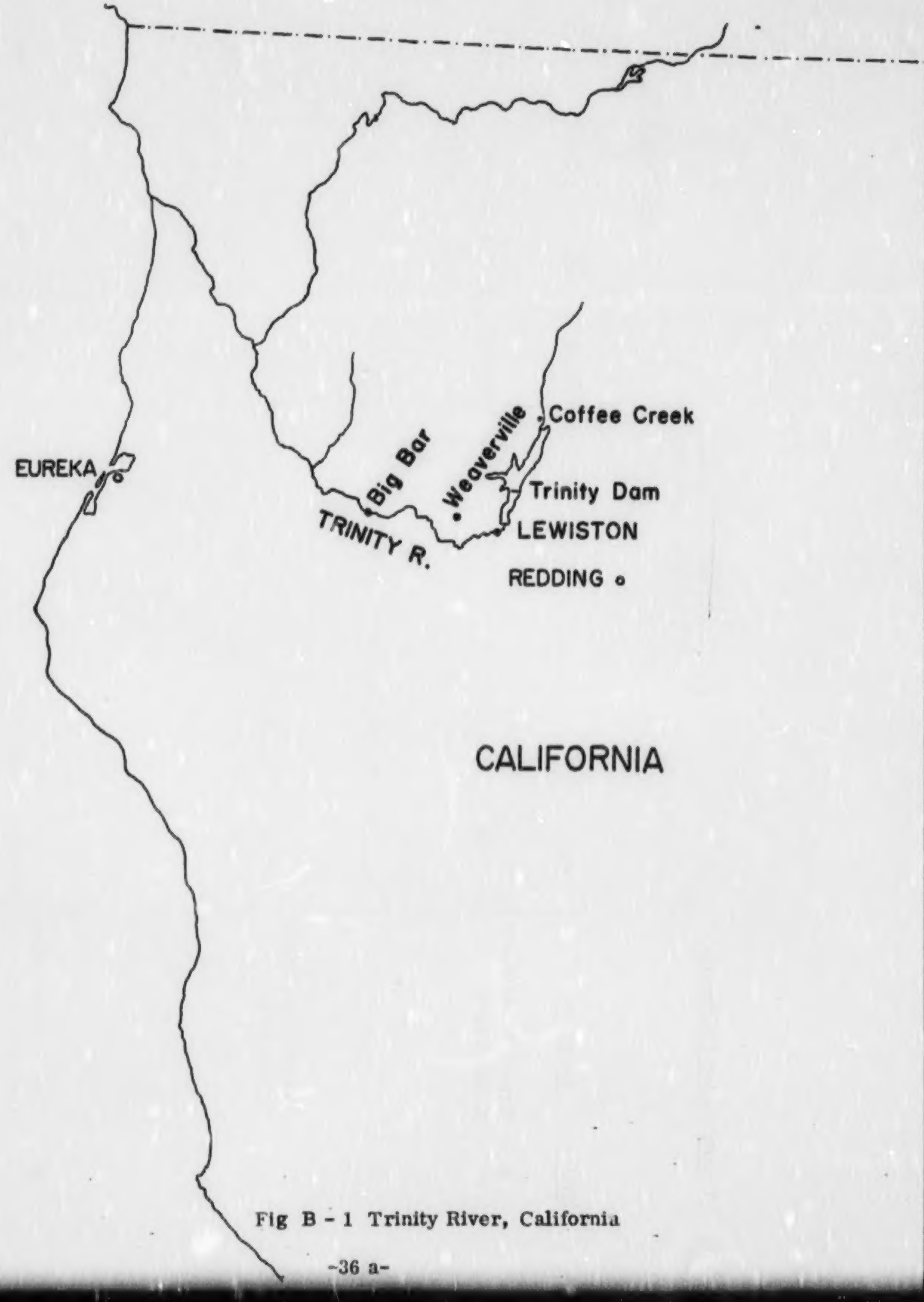
Coffee Creek
Weaverville
Big Bar
Trinity Dam
EUREKA
LEWISTON
TRINITY R.
REDDING
CALIFORNIA

Fig B - 1 Trinity River, California

Trinity Valley California

TABLE B-1

See Legend - page 29

		3/2/75					9/2/75-9/3/75				
Miles	Location	Depth	fpl	No. >5µm	tss mg/l	fibers counted	Depth	fpl	No. > 5µm	tss mg/l	fibers counted
0	Trinity River above Coffee Creek	surface	2.8(C)	0	28	21	only 1'	6.9(C)	0	na	14
			4.4(A)	0.4	28	33		11(A)	5.5	na	18
		1.0'	19(A)	0	31	3					
		1.0'(R)	BDL(6.28)	-	31	0					
21	Trinity River below Trinity Dam	surface	BDL(0.5)	-	2	0					
		5.0'	7.4(C)	1.5	21	10	3'	2.4(A)	0	na	5
		10.0'	0.52(A)	0	4	1	6'	2.24(A)	0	na	5
26	Trinity River below Lewiston Dam	surface	BDL(0.52)	-	9	0	0.5'	0.95(A)	0	na	2
		1.5'	BDL(0.74)	-	5	0	2.0'	1.6(A)	0	na	3
		2.5'	BDL(0.63)	-	7	0	4.0'	1.9(A)	9	na	4

Trinity Valley California, page two

TABLE B-1, con't.

		3/2/75					9/2/75-9/3/75				
Miles	Location	Depth	fpl	No. $>5\mu$m	tss mg/l	fibers counted	Depth	fpl	No. $> 5\mu$m	tss mg/l	fibers counted
57	Trinity River at Big Bar	surface	70(A)	0	51	5	0.5'	2.3(A)	0	na	4
		mid depth	37(A)	6.1	44	6	1.5'	1.6(A)	0	na	3
		bottom	37(A)	0	60	5	2.5'	9.3(A)	3.8	na	17
65	Trinity River at Cedar Flat	surface	4.8(C)	0	58	1	0.5'	0.84(A)	0	na	2
			9.7(A)	0	58	2	2.0'	BDL(0.41)	-	na	4
		mid depth	54(C)	6.7	60	8	4.0'	BDL(0.45)	-	na	0
			(R) 9(A)	0	60	3					
		bottom	6.7(A)	0	64	1					
			(R) 40(A)	0	60	7					

Trinity Valley California, page three

TABLE B-1, con't.

		3/2/75					9/2/75-9/3/75				
Miles	Location	Depth	fpl	No. >5µm	tss mg/l	fibers counted	Depth	fpl	No. > 5µm	tss mg/l	fibers counted
35-40	*Weaver Creek at Weaverville							1.7(A)	0	na	4
							(R)	3.8(A)	0.42	na	9
			BDL(4.8)	-	-	0					
	Weaverville town water sampled at drinking fountain		4.5(C)	0.56	2	8		0.41(A)	0	na	1
		3/3/75					9/3/75				
	** City of Redding water		BDL(1.26)	-	13	0	surface	8.6(A)	4.6	na	15
							3'	BDL(0.63)	-	na	0
							6'	BDL(0.55)	-	na	0
	City of Redding finished water		BDL(0.5)	-	8	0		0.84(A)	0	na	2
		(R)	BDL(0.5)	-	8	0					

* Weaver Creek joins the Trinity River at Weaverville and is the source of Weaverville town water.

** The City of Redding, although in the same general area as the Trinity Valley, draws its water from the Sacramento River, fed from Lake Shasta in the adjacent valley. On 3/3/75 the raw and finished water was sampled at the water plant. On 9/3/75 the raw water was sampled at the Sacramento River and the finished water was sampled at a faucet in the City of Redding.

Appendix C

Code: N4-N6

Various other California Sites

N4: Lake Oroville is a man-made lake fed by the north and west forks of the Feather River and constrained by the Oroville Dam which, at 770 feet is the highest dam in the United States and the highest earth filled dam in the world. Samples were then taken east of the north end of the dam in early March 1975 and again in early September. On both occasions little or no water was being released in order to build the water up to approximately 120 feet below maximum level.

N5: Folsom Lake is about half the size of Lake Oroville and lies 60 miles south of Oroville and 25 miles northeast of Sacramento. As in the case of Oroville, the reservoir was well below its maximum level and no water was being released. Sampling was carried out in early March and early September at the south end of Folsom Dam.

N6: The Stanislaus River system runs through highly serpentinized areas including the former asbestos producing region of Copperopolis. The Tulloch Reservoir lies about 10 miles south of Copperopolis. The New Melones Reservoir will lie upstream of Tulloch when it is completed. The area upstream of Tulloch is extremely rugged and cannot be reached without extreme difficulty. Samples were taken at a point called Robertson's Ferry where the water was swift but shallow. Additional samples were taken at the south shore of Tulloch Reservoir.

Various California sites

TABLE C - 1

See Legend - page 29

	3/3/75					9/4/75				
Location	Depth	fpl	No. >5μm	tss mg/l	fibers counted	Depth	fpl	No. > 5μm	tss mg/l	fibers counted
Lake Oroville at boat launching ramp above dam	surface	5.0(A)	2.5	7.0	2	surface	5.2(A)	1.3	0	4
	3'	BDL(2.5)	-	21	0	5'	4.5(A)	1.1	3	4
	6'	BDL(2.5)	-	7.0	0	10'	BDL(1.3)	-	2	0
			3/3/75					9/8/75		
Folsom Dam/Lake	surface	9.1(C)	0	5	15	0.5'	BDL(0.84)	-	4	0
	surface(R)	2.8(C)	0	5	4					
	2.5'	2.8(C)	0	9	4	5.0'	BDL(0.55)	-	7	0
	4.5'	8.4(C)	0	6	12	10'	BDL(0.87)	-	1	0
Stanislaus River, Robinson's Ferry	shallow rapids	BDL(2.62)	-	12	0	surface*	BDL(0.57)	-	5	0
						5.0'*	BDL(0.55)	-	6	0
						10'*	BDL(0.57)	-	7	0
	20 yds down stream from rapids	BDL(1.93)	-	16	0					

* Not at Robinson's Ferry

Various California sites, page two

TABLE C-1, con't.

Location	Depth	fpl	No. >5μm	tss mg/l	fibers counted	Depth	fpl	No. > 5μm	tss mg/l	fibers counted
Tulloch Reservoir at Marina Dock, South Shore	surface	BDL(1.6)	-	6	0	0.5'	BDL(0.48)	-	0	0
						5.0'	BDL(0.63)	-	1	0
						5.0'(R)	BDL(0.68)	-	1	0
	6.0'	7.2(C)	0	19	5	10.0'	BDL(0.57)	-	0	0
	11'(R)	21(C)	2.2	10	38					
		0.56(A)	0.56		1					

Appendix D

Code: N3

Connecticut River, New Hampshire and Vermont

In its upper reaches the Connecticut River flows from the sparsely populated region of northern New Hampshire down the entire length of the New Hampshire-Vermont boundary. Below the Windsor County-Orange County border possible interferences might arise due to mining activities, principally talc mines.

Samples were taken in northern New Hampshire at Second Connecticut Lake near the dam outlet, at First Connecticut Lake near the dam outlet and above Murphy Dam at the southern end of Frances Lake. Along the boundary of Vermont and New Hampshire samples were taken from the Connecticut River at North Stratford, New Hampshire; at Dalton, New Hampshire; at Wells River Junction, Vermont; White River Junction, Vermont; the Vermont side of North Walpole; and above the dam at Vernon, Vermont. Samples were taken in mid-July and in October 1975.

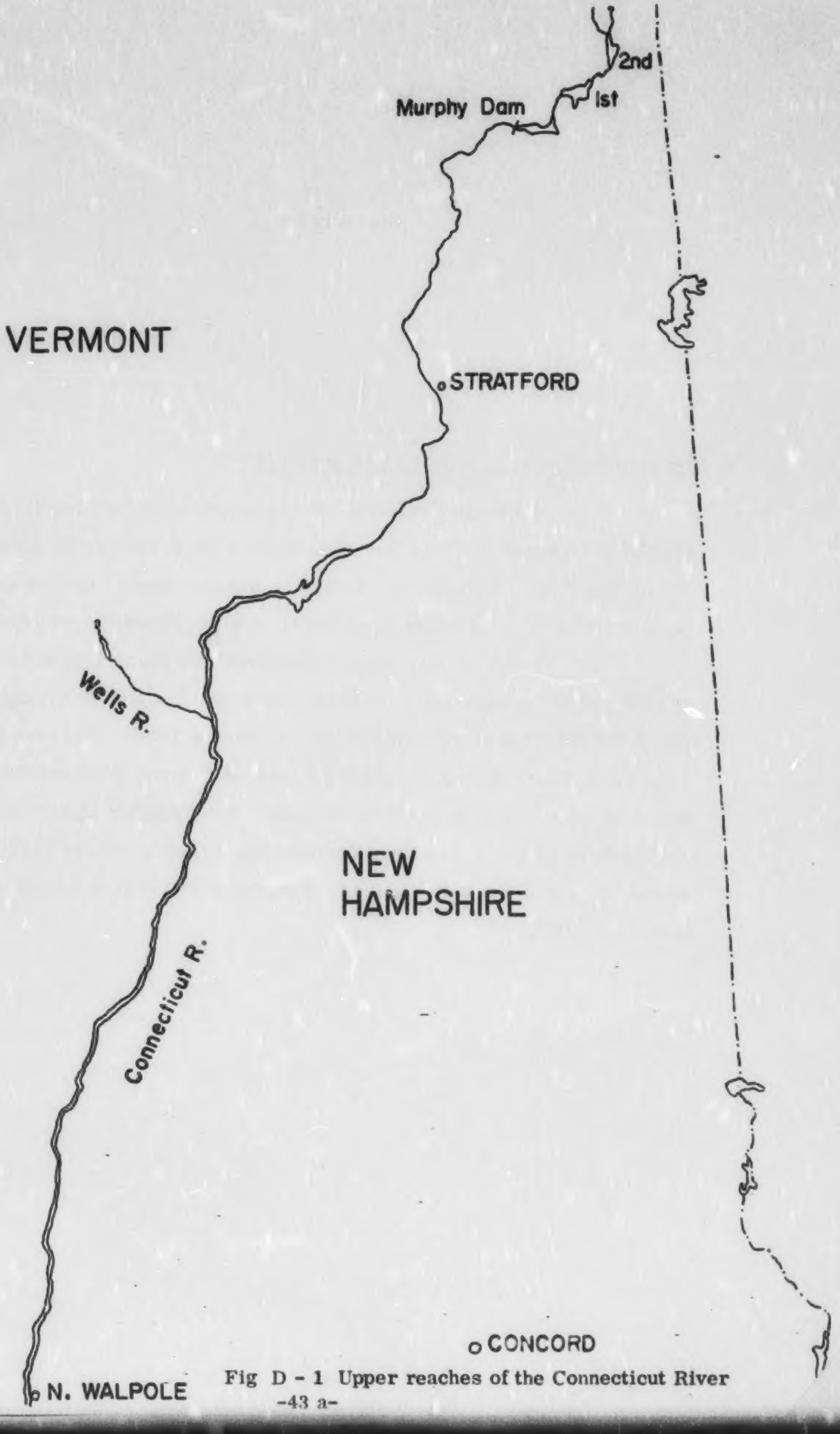
2nd
Ist
Murphy Dam
VERMONT
STRATFORD
Wells R.
NEW HAMPSHIRE
Connecticut R.
CONCORD
N. WALPOLE

Fig D - 1 Upper reaches of the Connecticut River

Connecticut River

TABLE D - 1

See Legend - page 29

		7/17/75					10/12/75				
Miles	Location	Depth	fpl	No. >5µm	tss mg/l	fibers counted	Depth	fpl	No. > 5µm	tss mg/l	fibers counted
0	2nd Connecticut Lake nr dam outlet	3'	4.9(C)	0	5	7	3'	BDL(0.25)	-	14	0
		7'	26(C)	0	15	15	7'	BDL(0.25)	-	0	0
6	1st Connecticut Lake		0.84(C)	0	1	3		BDL(0.25)	-	3	0
13	Francis Lake (above Murphy dam)	(R)	67(C)	8.4	2	24		BDL(0.25)	-	1	0
			24(C)	2.5	2	19					
37	Connecticut River at N. Stratford, N.H. (Jct, Rtes 3 & 105)		5.0(C)	0	4	3		BDL(0.84)	-	64	0
61	Connecticut River, 1 mile upstream of Dalton, N.H.		7.0(C)	0	8	5		BDL(0.25)	-	2	0
							(R)	1.0 (C)	0	2	4

Connecticut River, page two

TABLE D - 1. con't.

		7/17/75					10/12/75				
Miles	Location	Depth	fpl	No. >5μm	tss mg/l	fibers counted	Depth	fpl	No. > 5μm	tss mg/l	fibers counted
89	Connecticut River, Wells River Jct. (jct. Rtes 5 & 302)		22(C)	1.6	5	14		BDL(1.3)	-	26	0
126	Connecticut River, White River Jct.		6.2(C)	1.7	8	11		BDL(1.3)	-	46	0
159	Connecticut River at North Walpole	3'	11(C)	0	8	10		BDL(0.42)	-	6	0
		12'	25(C)	2.8	4	18					
183	Connecticut River at Vernon, N. of power station		BDL(1.3)	-	13	0		BDL(1.0)	-	15	0
		(R)	BDL(1.3)	-	13	0					

Appendix E

Hiwassee River Valley, Georgia and North Carolina Code: N7

The Hiwassee River flows through hills and marshland from northern Georgia into North Carolina where it turns westward and widens to form Lake Hiawassee.

Samples were taken at Presley, Georgia where the Hiawassee River originates and at the Chatuge Dam which is about 10 miles north and at the northern rim of the lake.

Little Tennessee River Valley, Georgia, North Carolina and Tennessee Code: N8

The Little Tennessee River rises in Rabun Gap, Georgia near Clayton, then flows north into North Carolina through hilly country with considerable exposures of micaceous rock. It then flows northwesterly through rugged hills, passing through Fontana Lake on its way to the Tennessee River and Chattanooga.

Samples were taken at Dillard, Georgia; Norton, North Carolina; Otto, North Carolina; Prentiss, North Carolina; at the Fontana Dam which is on the southwest side of Fontana Lake; Watts Bar Dam, Tennessee on the Tennessee River north of Chattanooga; and Chattanogga, Tennessee.

Samples were obtained in early April and late November 1975.

Chatooga - Savannah River Valley, Georgia and S. Carolina Code: N9

The Savannah River is fed by waters originating at Burton Lake several miles west of Clayton, Georgia. It flows southeasterly through Tugaloo Lake and empties into the Atlantic Ocean at Savannah, Georgia.

Samples were obtained from the Chattooga River east of Clayton at Tallulah Falls; from the Tallulah River between Rabun Lake and Burton Lake; from Tugaloo Lake Dam; above and below the dam at Hartwell Reservoir on the Savannah River; and at the towns of Greenville and Anderson, South Carolina.

Samples were obtained in early April and late November 1975.

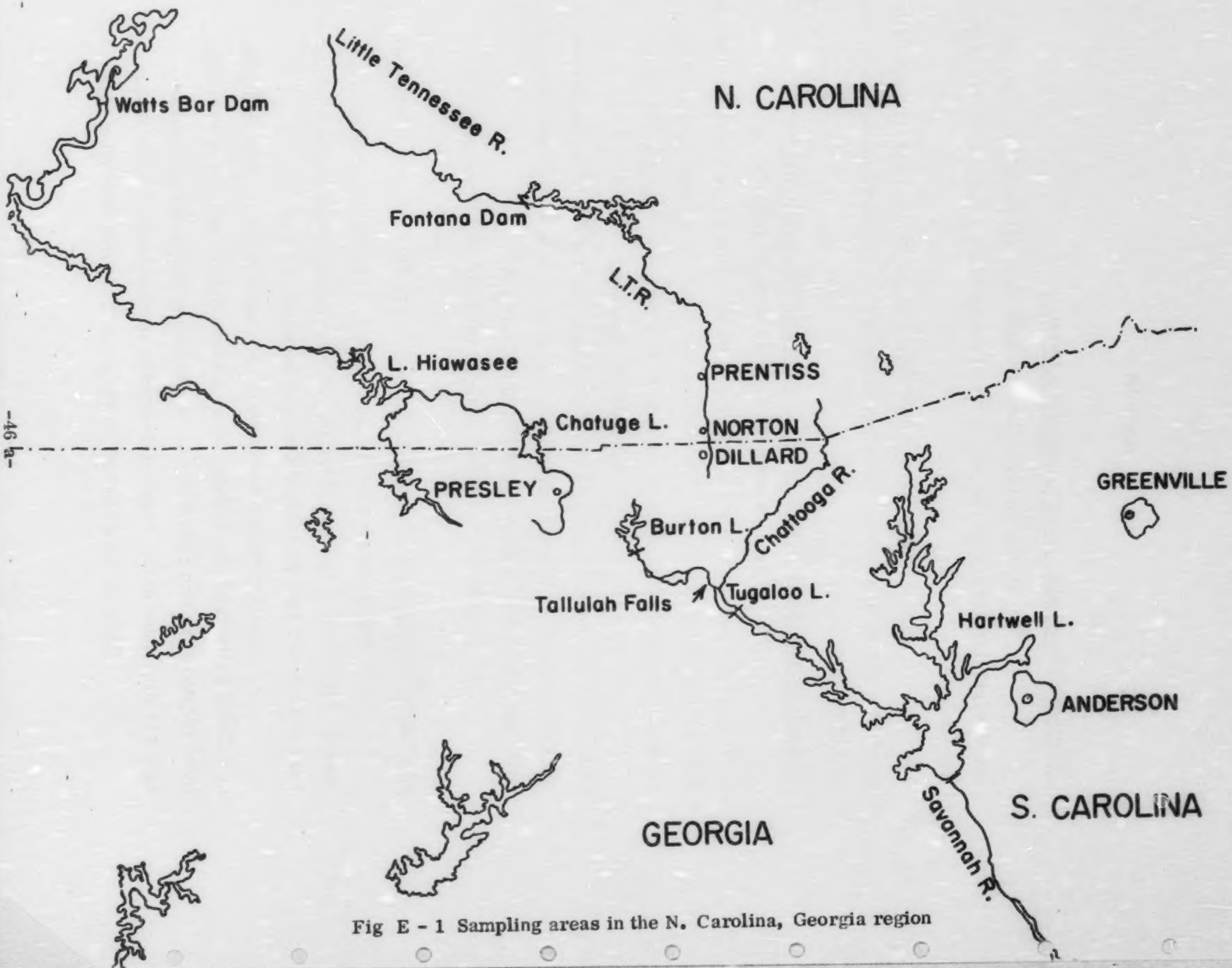
N. CAROLINA
Watts Bar Dam
Little Tennessee R.
Fontana Dam
L.T.R.
L. Hiawasee
PRENTISS
Chatuge L.
NORTON
DILLARD
PRESLEY
Burton L.
Chattooga R.
Tallulah Falls
Tugaloo L.
GREENVILLE
Hartwell L.
ANDERSON
S. CAROLINA
GEORGIA
Savannah R.

Fig E - 1 Sampling areas in the N. Carolina, Georgia region

Hiwassee River (Georgia/North Carolina)

TABLE E-1

See Legend - page 29

		4/4/75					11/27/75				
Miles	Location	Depth	fpl	No. >5μm	tss mg/l	fibers counted	Depth	fpl	No. > 5μm	tss mg/l	fibers counted
0	Hiwassee River nr. Presley		BDL(0.84)	-	15	0		BDL(1.3)	-	7	0
		(R)	BDL(0.84)	-	15	0					
5-10	Hiwassee River above Chatuge Lake dam	0.5'	BDL(0.84)	-	16	0		1.3(C)	0	5	2
		4.0'	BDL(2.5)	-	28	0					
5-10	Hiwassee River below Chatuge Lake dam	0.5'	BDL(0.84)	-	12	0		BDL(0.63)	-	5	0

Little Tennessee River (Georgia, North Carolina, Tennessee)

TABLE E - 2

		4/4/75					11/27/75				
Miles	Location	Depth	fpl	No. >5μm	tss mg/l	fibers counted	Depth	fpl	No. > 5μm	tss mg/l	fibers counted
0	Little Tennessee R. (LTR) nr Dillard, GA, Rte 23		BDL(2.1)	-	34	0		18(C)	0	21	14
2.5	LTR at Norton, N. C.		BDL(3.6)	-	32	0		BDL(2.1)	-	30	0
5.0	LTR nr Otto, N. C.		BDL(2.5)	-	34	0		BDL(2.1)	-	38	0
9.0	LTR, Prentiss, N. C.		BDL(0.6)	-	33	0		BDL(1.3)	-	17	0
11.0	LTR, above Fontana Dam, N. C.	0.5'	1.8(C)	0	13	7	surface	3.5(C)	0.5	6	7
		4'	1.8(C)	0	13	7	4'	1.5(C)	0	8	3
		8'	BDL(0.25)	-	13	0	10'	47(C)	7.0	5	47

Little Tennessee River (Georgia, North Carolina, Tennessee), page two

TABLE E - 2, con't.

		4/4/75					11/27/75				
Miles	Location	Depth	fpl	No. >5µm	tss mg/l	fibers counted	Depth	fpl	No. > 5µm	tss mg/l	fibers counted
45	LTR below Fontana Dam, N.C.	surface	5.0(C)	0	13	20	surface	5.0(C)	0	6	10
		4'	3.0(C)	0.5	12	12	2'	BDL(0.5)	-	8	0
		8'	BDL(0.25)	-	13	0					
		8'(R)	3.9(C)	0.13	18	31					
							11/28/75				
120	Watts Bar Dam	1'	15(C)	0	41	6	surface	BDL(0.84)	-	6	0
		4'	8.4(C)	0	49	4					
		4/3/75									
	* City of Chattanooga Raw water		BDL(2.5)	-	46	0		0.75(C)	0.75	2	3
			19(A)	1.1	46	17**					
	City of Chattanooga Finished water		4.7(C)	0.13	12	37		BDL(0.13)	-	2	0

* Chattanooga, Tennessee draws its water supply from the Tennessee River

** Listed as "possible" amphibole

Chatooga Savannah River

TABLE E - 3

		4/5/75					11/26/75				
Miles	Location	Depth	fpl	No. >5µm	tss mg/l	fibers counted	Depth	fpl	No. > 5µm	tss mg/l	fibers counted
0	Tallulah River below L. Burton		BDL(0.31)	-	17	0		BDL(0.25)	-	6	0
5	Tallulah River at Tallulah Falls		BDL(0.84)	-	15	0		BDL(0.13)	-	6	0
* 8.5	Chatooga River, 7 mi E/Clayton, Rte 76		32.6(C)	2.5	na	26		BDL(0.42)	-	4	0
		(R)	BDL(1.3)	-		0					
14	Chatooga River below Tugaloo Dam	surface	BDL(0.38)	-	24	0	surface	BDL(0.31)	-	5	0
		4'	BDL(0.90)	-	20	0	2'	BDL(0.31)	-	4	0
50	Lake Hartwell above Hartwell Dam	surface	BDL(0.25)	-	20	0	surface	BDL(0.42)	-	6	0
		surface(R)	BDL(0.25)	-	20	0	3'	BDL(0.42)	-	3	0
		4'	BDL(0.26)	-	13	0					

* The Chatooga River joins the Tallulah River at 8.5 miles, but was sampled 6.5 miles upstream of their confluence; date of 2nd sampling is 11/27/75.

Chatooga Savannah River, page two

TABLE E - 3, con't.

		4/5/75					11/26/75				
Miles	Location	Depth	fpl	No. >5μm	tss mg/l	fibers counted	Depth	fpl	No. > 5μm	tss mg/l	fibers counted
50	Savannah River below Hartwell Dam	surface	BDL(0.42)	-	16	0	surface	BDL(0.42)	-	4	0
		4'	BDL(0.43)	-	24	0	2'	BDL(0.42)	-	4	0
**45	City of Anderson raw water		BDL(1.8)	-	29	0		BDL(0.42)	-	5	0
50	City of Anderson finished water		BDL(0.13)	-	9	0		BDL(0.13)	-	7	0
	***City of Greenville raw water		BDL(0.13)	-	11	0		BDL(0.13)	-	5	0
	City of Greenville raw water	(R)	BDL(0.13)	-	11	0					

** The City of Anderson draws its water from Lake Hartwell

*** Although not obtaining water from the Savannah River, the city of Greenville is in the same general area and draws its water from Table Rock Lake Reservoir and North Saluda basin.

Chatooga Savannah River, page three

TABLE E - 3, con't.

			4/5/75					11/26/75		
Miles	Location	Depth	fpl	No. >5µm	tss mg/l	fibers counted	Depth	fpl	No. > 5µm	tss mg/l	fibers counted
	City of Greenville finished water, Table Rock Reservoir		BDL(0.13)	-	11	0		BDL(0.13)	-	5	0
	City of Greenville finished water, Town station		BDL(0.12)	-	10	0		BDL(0.13)	-	5	0

Appendix F

Cities associated with natural sites

Water from five cities, who derive their water supplies from the natural sites studied, was examined for its asbestos content. Both raw and finished water were sampled.

Individual descriptions of the water sources and treatment facilities are included in this appendix together with the data obtained. These data are summarized in the following table in alphabetical order.

TABLE F - 1

Asbestos in city water supplies associated with natural sites

City	Sample	Date	fpl x 10^6	Date	fpl x 10^6
Anderson, SC	Raw	4/10/75	BDL(1.8)	11/26/75	BDL(0.42)
	Finished	4/10/75	BDL(0.13)	11/26/75	BDL(0.13)
Chatanooga, TN	Raw	4/ 3/75	BDL(2.5)	11/28/75	0.75(C)
	Finished	4/ 3/75	4.7(C)	11/28/75	BDL(0.13)
Greenville, SC	Raw	4/10/75	BDL(0.13)	11/26/75	BDL(0.13)
	(1) Finished	4/10/75	BDL(0.13)	11/26/75	BDL(0.13)
	(2) Finished	4/10/75	BDL(0.12)	11/26/75	BDL(0.13)
Redding, CA	Raw	3/ 2/75	BDL(1.26)	9/ 3/75	(1) 8.6(A) (2) BDL(0.63) (3) BDL(0.55)
	Finished	3/ 2/75	BDL(0.5)	9/ 3/75	0.84(A)
Weaverville, CA	Raw	3/ 2/75	BDL(4.8)	9/ 2/75	2.85(A)
	Finished	3/ 2/75	4.5(C)	9/ 2/75	0.41(A)

City	Anderson, South Carolina	Population 27,560.
Water Department	Duke Power Company Contact: E.A. Orr, Superintendent Phone: 803-224-6363	
Water Source	Lake Hartwell	
Water Treatment	1) Caustic soda and alum sulfate 2) Prechlorinate 3) Rapid sand filter 4) Clearing well 5) Reservoir 6) Post chlorinate, fluoridate, phosphate	
Comments	Raw and Finished water was sampled in April and November at the Hartwell Lake Pumping Station	

Asbestos analysis

Date	fpl	fpl >5μm	fibers observed	Comments
4 10 75	BDL(1.8)	-	0	Raw
4 10 75	BDL(0.13)	-	0	Finished
11 26 75	BDL(0.42)	-	0	Raw
11 26 75	BDL(0.13)	-	0	Finished

City Chattanooga, Tennessee Population 119,000

Water Department Tennessee American Water Company
Contact: Gene Hargraves, Water Quality Supervisor
Phone: 615-267-0021, extension 65 or 66

Water Source Tennessee River usage approx. 54 m.g.d.

Water Treatment
1) prechlorination + alum treatment (flocculation)
2) pH adjustment - lime addition
3) settling basins
4) filters - 2 types a) sand and gravel; b) mixed media (hi-rate micro floc)
5) pH adjustment - lime addition
6) fluoridation (hydrofluosilicic acid)
7) chlorination -to free Cl level of at least 0.5 ppm

Asbestos analysis

Date	fpl	fpl >5μm	fibers observed	Comments
4 3 75	BDL(2.5)	-	0	Raw
4 3 75	4.7(C)	0.13	37	Finished
11 28 75	0.75(C)	0	3	Raw
11 28 75	BDL(0.13)	-	0	Finished

City	Greenville, South Carolina	Population 61,500
Water Department	Greenville Water System 206 South Main Street, Greenville, South Carolina Contact: M.C. Moeller, Assistant Manager Phone: 803-242-6510	
Water Source:	Table Rock Lake Reservoir and North Saluda Basin usage approx. 42 m.g.d.	
Water Treatment	Very little treatment - chlorinate, add a little ammonia, adjust pH with soda ash to 8.8 - 8.9	
Comments	Greenville Water System owns the complete Table Rock Lake - North Saluda watershed. Raw and finished water samples were taken at the Table Rock station and a second finished water was taken at the town station	

Asbestos analysis

Date	fpl	fpl >5μm	fibers observed	Comments
4 10 75	BDL(0.13)	-	0	Raw
4 10 75	BDL(0.13)	-	0	Finished at Table Rock
4 10 75	BDL(0.12)	-	0	Finished at Town Station
11 26 75	BDL(0.13)	-	0	Raw
11 26 75	BDL(0.13)	-	0	Finished at Table Rock
11 26 75	BDL(0.13)	-	0	Finished at Town Station

City	Redding, California	Population 16,660
Water Department	Redding Water and Electric Utilities Contact: Robert Galeusha, Public Works Superintendent Phone: 916-246-1151	
Water Source	Sacramento River	Usage approx 10 m.g.d.
Water Treatment	1) Prechlorination 2) Alum + lime 3) Settling reservoir 4) Main reservoir (7 million gallons) 5) Postchlorinate	
Comments	Redding water was sampled on two occasions. On the first visit (3.3.75) samples of raw and finished water were collected at the water works. On the second visit (9.3.75) finished water was sampled at a faucet in the Holiday Inn Motel and raw water was sampled at the Sacramento River in the Kutras Park bird sanctuary.	

Asbestos analysis

Date	fpl	fpl >5μm	fibers observed	Comments
3 2 75	BDL(1.26)	-	0	Raw
	BDL(0.5)	-	0	Finished
9 3 75	BDL(0.63)	-	0	Sacramento River 6 ft depth
	BDL(0.55)	-	0	Sacramento River 3 ft depth
	8.6(A)	4.6	15	Sacramento River surface
	0.84(A)	0	2	Finished

City	Weaverville, California	Population 1,489
Water Department	California Pacific Utilities Contact: John Redding, Murphy Loft Phone: 916-623-5536	
Water Source	East Weaver Creek	usage approx. 700,000 gal/month
Water Treatment	1) Settling pond - chlorinate in pond 2) Transfer to reservoir, rechlorinate	
Comments	Weaverville water works was not visited. Raw water was obtained from the East Weaver Creek and finished water from a drinking fountain in the public park. The water level in Weaver Creek was noted as "very low" during the September visit. Weaverville is situated at the confluence of Weaver Creek and the Trinity River	

Asbestos analysis:

Date	fpl	fpl >5μm	fibers observed	Comments
3 2 75	BDL(4.8)	-	0	Raw
3 2 75	4.5(C)	0.56	8	Finished
9 2 75	1.7(A)	0	4	Raw
	3.8(A)	0.42	9	Raw
9 2 75	0.41(A)	0	1	Finished

Appendix G

Cities associated with manufacturing plants

The incoming water supplies of 12 plants who obtain their water from local municipal supplies were analyzed with the results shown in Table G-1. Individual descriptions of the water treatment facilities of these municipalities are included in this Appendix.

No evidence of asbestos was detected in six of the water supplies. The pattern of the results in the remaining six suggest that almost all represent stray contamination in the plant. At Van Buren, AR the majority of the fibers present are well separated unit fibrils of chrysotile, suggesting that in this case the asbestos is indigenous to the water supply.

TABLE G - 1

See Legend - page 29

City	Appendix	Date	fpl x 10^6	fpl x $10^6 > 5\mu m$	No. of fibers observed
Billerica, MA	R	7/24/75	BDL(0.17)	-	0
Erie, PA	V	7/ 8/75	BDL(1.3)	-	0
		7/ 8/75(R)	2.5(C)	0	2
		7/ 9/75	9.9(C)	1.2	8
		11/ 6/75	160(C)	28	34
Kankakee, IL	Z	7/ 1/75	BDL(0.29)	-	0
Lead, SD	*	6/17/75	BDL(0.53)	(raw water)	0
		6/17/75	BDL(0.81)	(finished)	0
		8/20/75	BDL(0.25)	(raw water)	0
Manville, NJ	H	5/ 5/75	BDL(0.52)	-	0
		5/ 6/75	BDL(0.17)	-	0
		5/ 7/75	BDL(0.26)	-	0
		5/ 8/75	BDL(0.5)	-	0
		10/22/75	BDL(0.25)	-	0
		10/23/75	BDL(0.31)	-	0
Marshville, NC	CC	4/14/75	BDL(0.13)	-	0
		4/15/75	88(C)	0**	35
New Orleans, LA	N	3/25/75	BDL(1.1)	-	0
		3/26/75	0.88(C)	0.13	7
		3/27/75	BDL(1.3)	-	0
		12/ 4/75	BDL(0.5)	-	0
		12/ 5/75	TNTC($\gg 10^9$)		
No. Charleston, SC	BB	4/ 8/75	BDL(0.13)	-	0
		4/ 9/75	BDL(0.13)	-	0
		11/24/75	BDL(0.13)	-	0
		11/25/75	BDL(0.13)	-	0

* This location to be reported with data on Mining and Accessory Mineral sites.

** Only 5 x 10^6 fpl $> 2\mu m$

Pittsburg, CA	T		3/ 4/75	BDL(0.89)	-	0
Stratford, CT	AA		8/ 6/75	BDL(0.3)	-	0
			8/ 6/75(R)	BDL(0.3)	-	0
			8/ 7/75	0.38(A)	0	1
			8/ 8/75	5.7(C)	3.3	16
			10/20/75	BDL(0.38)	-	0
			10/21/75	BDL(0.25)	-	0
St. Louis, MO	L and O	L	2/10/75	BDL(1.05)	-	0
		O	2/10/75	0.08(C)	0	1
		O	2/10/75(R)	BDL(0.13)	-	0
		L	2/11/75	BDL(0.42)	-	0
		O	2/11/75	0.16(C)	-	1
				4.7(A)	1.9	30
		O	2/11/75	BDL(0.13)	-	0
		L	2/12/75	BDL(0.91)	-	0
		O	2/12/75	BDL(0.45)	-	0
		O	2/12/75	BDL(0.28)	-	0
		L	1/15/76	4.9(C)	0.88	39
		O	1/15/76	BDL(0.25)	-	0
Van Buren, AR	K		2/ 6/75	*40(C)	5.0	32

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* Very small fibers - >90% present as unit fibrils.

City	Billerica, Massachusetts	Population 4,500
Water Department	Contact: Lee Garrant, Assistant Superintendent of Treatment Phone: 617-663-2235	
Water Source	Concord River	usage approx. 4 m.g.d., can rise to 9 m.g.d. in summer months
Water Treatment	1) screened — pump well 2) baffled activated carbon contact chamber 3) mix basins, chlorine, alum and NaOH added 4) 1st flocculation basin 5) 2nd flocculation basin 6) sedimentation 7) filters 8) chlorination, pH adjustment (NaOH)	
Comments	Only finished water was sampled, the samples being taken at the Johns-Manville A-C Sheet plant in Billerica.	
Asbestos analyses		

Date	fpl	fpl >5μm	fibers observed	Comments
7 24 75	BDL(0.17)	-	0	-

City	Erie, Pennsylvania	Population 129,200
Water Department	Erie Water Company Contact: Norman Jacquel, Chief Chemist at filter plant Phone: 814-456-8561 (City Hall)	
Water Source	Lake Erie	Usage 40-45 m.g.d.
Water Treatment	1) Alum addition 2) Settling basin 3) Filter bed - activated carbon + sand 4) Chlorinate If necessary, will at times add potassium permanganate for taste problems	
Comments	Water sampled at G.A.F. plant on 7.8.75	
Asbestos analysis		

Date	fpl	fpl >5μm	fibers observed	Comments
7 8 75	BDL(1.3)	-	0	-
7 8 75	2.5(C)	0	2	-
7 9 75	9.9(C)	1.2	8	-
11 6 75	160(C)	28	34	-

City	Kankakee, Illinois	Population 31,940
Water Department	Kankakee Water Company Contact: Robert Burmann, Superintendent, Water Department Phone: 815-933-7703	
Water Source	Kankakee River	Usage 10.5 m.g.d.
Water Treatment	1) Soften - lime + soda ash 2) Coagulate - alum 3) Activated carbon 4) Settling 5) Rapid filter - coal + mixed media 6) Chlorinate	
Comments	Water was sampled at the Armstrong Cork tile plant at Kankakee	

Asbestos analysis

Date	fpl	fpl >5μm	fibers observed	Comments
7 1 75	BDL(0.29)	-	0	-

City	Lead, South Dakota	Population 5,420
Water Department	Homestake Mines Contact: Robert Sliper, Chief Construction Engineer Phone: 605-584-1021, extension 321	
Water Source	Natural spring water	usage approx. 3 m.g.d.
Water Treatment	Fluoridation and chlorination only	
Comments	Finished water sampled at Homestake Mine. Raw water believed equivalent to water sampled at Spearfish Creek	

Asbestos analysis

Date	fpl	fpl >5μm	fibers observed	Comments
6 17 75	BDL(0.53)	-	0	Raw
6 17 75	BDL(0.81)	-	0	Finished
8 20 75	BDL(0.25)	-	0	Raw

City	Manville, New Jersey	Population 13,030
Water Department	Manville Water Department Contact: Edward Pirzycki, Superintendent Phone: 201-725-0241	
Water Source	Deep and shallow wells	usage 1 to 1.3. m.g.d.
Water Treatment	Chlorination plus addition of Calgon compound to keep iron in solution	
Comments	Only finished water was sampled, at the Johns-Manville multi-product plant in Manville	

Asbestos Analyses

Date	fpl	fpl >5μm	fibers observed	Comments
5 5 75	BDL(0.52)	-	0	-
5 6 75	BDL(0.17)	-	0	-
5 7 75	BDL(0.26)	-	0	-
5 8 75	BDL(0.5)	-	0	-
10 22 75	BDL(0.25)	-	0	-
10 23 75	BDL(0.31)	-	0	-

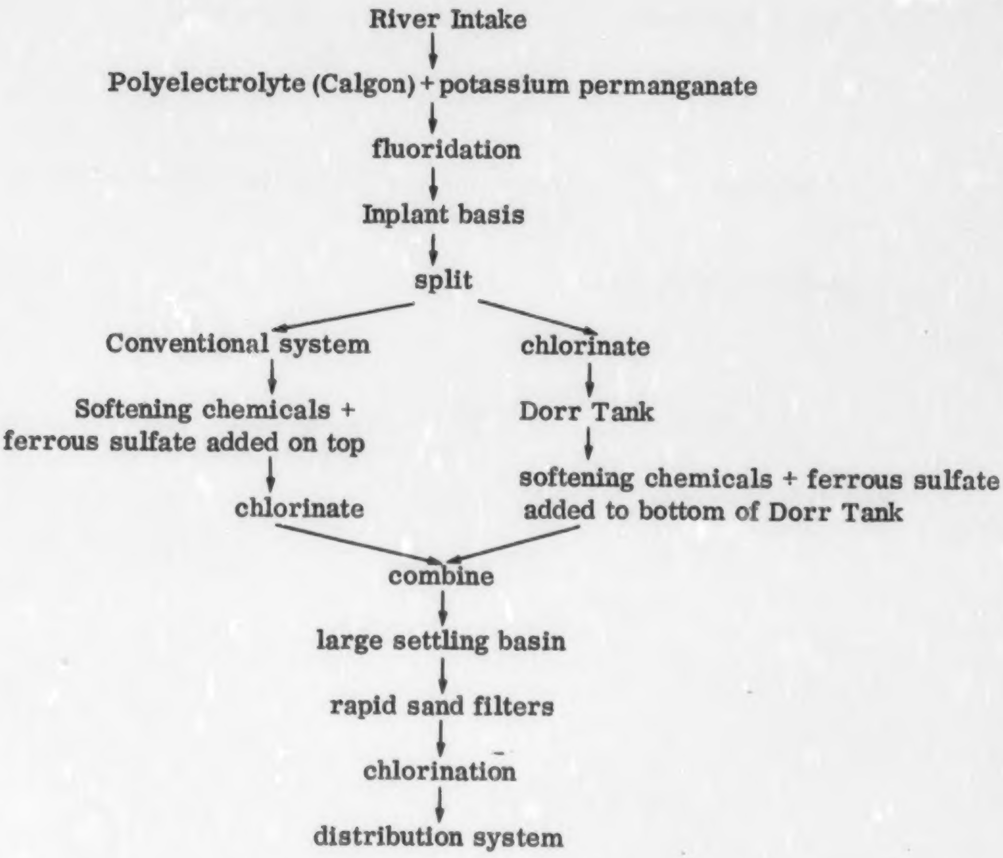
City	Marshville, North Carolina	Population 1,405
Water Department	Marshville Water Treatment Plant Contact: Reese Hamilton, Chief Operator Phone: 704-624-5408	
Water Source	Lane Creek (approximately 5 miles East of Marshville) Usage approx 0.5 m.g.d. also purchase approx 0.2 m.g.d. from Anson County having similar treatment facilities	
Water Treatment	1) Flocculate with alum sulfate 2) pH adjust with NaOH 3) Chlorinate (approx 1 ppm free Cl^-) 4) Fluoridate	
Comments	Water was sampled at the Raybestos Manhattan plant at Marshville	

Asbestos analysis

Date	fpl	fpl $>5\mu m$	fibers observed	Comments
4 14 75	BDL(0.13)	-	0	-
4 15 75	88(C)	0*	35	-

* only 5×10^6 fpl $>2\mu m$

City	New Orleans, Louisiana	Population 593,000 .
Water Department	Sewage and Water Board of New Orleans Contacts: James Bechnell, Water Plant Supervisor Lewis Langley, Chemist Phone: 504-861-0331	
Water Source	Mississippi River	Usage 125 m.g.d.
Water Treatment	The water treatment cycle is best shown as a schematic flow diagram	


River Intake
Polyelectrolyte (Calgon) + potassium permanganate
fluoridation
Inplant basis
split
Conventional system
chlorinate
Softening chemicals + ferrous sulfate added on top
Dorr Tank
chlorinate
softening chemicals + ferrous sulfate added to bottom of Dorr Tank
combine
large settling basin
rapid sand filters
chlorination
distribution system

Comments Finished water samples were taken at the National Gypsum Company A.C. sheet plant. A sample of Mississippi River water was also taken.

New Orleans, Louisiana, con't.

Date	fpl	fpl >5μm	fibers observed	Comments
3 25 75	BDL(1.1)	-	0	-
3 26 75	0.88(C)	0	7	-
3 27 75	BDL(1.3)	-	0	-
12 4 75	BDL(0.5)	-	0	-
12 5 75	TNTC $\gg 10^9$	-	-	-

City	North Charleston, South Carolina	Population 78,000
Water Department	Commission of Public Works, Charleston Contact: Robert Bowers, Assistant Superintendent Phone: 803-723-9411	
Water Source	Edisto River	Usage 30 -40 m.g.d.
Water Treatment	1) Alum sulfate 2) Settling 3) Chlorinate 4) Rapid filter - sand and gravel 5) p.H adjust (NaOH) 6) Chlorinate	
Comments	Water was sampled at Raybestos-Manhattan plant at North Charleston	

Asbestos analysis

Date	fpl	fpl $>5\mu m$	fibers observed	Comments
4 8 75	BDL(0.13)	-	0	-
4 9 75	BDL(0.13)	-	0	-
11 24 75	BDL(0.13)	-	0	-
11 25 75	BDL(0.13)	-	0	-

City	Pittsburg, California	Population 20,650
Water Department	Contra Costa Water District, Concord, California Contact: Al Lange, Chemist Phone: 415-682-5950	
Water Source	Sacramento and San Joaquin Delta System	
Water Treatment	1) Alum addition + chlorination 2) Lime added to adjust pH 3) Filter - polyelectrolyte filter aid 4) Chlorinate if needed 5) Fluoridate 6) Final pH adjust with NaOH	
Comments	Water sampled at Johns-Manville plant in Pittsburg. Contra Costa supplies Johns-Manville with raw water for process use. This is pumped by J.M. from a ditch or canal alongside the estuary. Water was sampled from a faucet in the wash room at J.M. and was indicated as city water and is therefore, presumably, "finished".	

Asbestos analysis

Date	fpl	fpl $>5\mu m$	fibers observed	Comments
3 4 75	BDL(0.89)	-	0	-

City St. Louis, Missouri Population 622,000

Water Department St. Louis Municipal Water Department
Contact: Walter Zollman, Chief Chemical Engineer
Phone: 314-867-1520

Water Source Major source is the Missouri River, but also have a plant on the Mississippi

Water Treatment

1) chlorination (water kept moving)
2) presedimentation
3) precoagulation (lime added)
4) settling basins (5 basins, capacity 30 million gallons)
5) reduce velocity, chlorinate and add ferrous sulfate
6) secondary mix
7) settling basins (3 basins)
8) fluoridate
9) sand filter

Comments Finished water only was sampled at two asbestos plants - the Certain Teed A-C pipe plant and the neighboring GAF A-C sheet plant

Asbestos analysis

Plant	Date	fpl	fpl >5μm	fibers observed	Comments
Certain Teed(C.T.)	2 10 75	BDL(1.05)	-	-	-
GAF	2 10 75	0.08(C)	0	1	-
		1.5(A)	0.63	19	-
GAF	2 10 75(R)	BDL(0.13)	-	0	-
C.T.	2 11 75	BDL(0.42)	-	0	-
GAF	2 11 75	0.16(C)	-	1	-
		4.7(A)	1.9	30	-
GAF	2 11 75	BDL(0.13)	-	0	-
C.T.	2 12 75	BDL(0.91)	-	0	-
GAF	2 12 75	BDL(0.45)	-	0	-
GAF	2 12 75	BDL(0.28)	-	0	-
C.T.	1 15 76	4.9(C)	0.88	39	-
GAF	1 15 76	BDL(0.25)	-	0	-

City	Stratford, Connecticut	Population 49,775
Water Department	Bridgeport Hydraulic Contact: Dan Minelli, Chemist, Quality Control Lab Phone: 203-367-6621	
Water Source	Trap Falls Reservoir	Usage - Reservoir usage, approx 15 m.g.d. of which Stratford uses approx 1/2
Water Treatment	1) Chlorinate 2) pH adjust (lime added) 3) Fluoridation 4) Phosphate added for corrosion protection	
Comments	City water was sampled at the Raybestos Manhattan plant, 15 East Main Street, Stratford, on two occasions — in August 1975 and in October 1975.	

Asbestos analyses

Date	fpl	fpl $>5\mu m$	fibers observed	Comments
8 6 75	BDL(0.3)	-	0	-
8 6 75	BDL(0.3)	-	0	-
8 7 75	0.38(A)	0	1	-
8 8 75	5.7(C)	3.3	16	-
10 20 75	BDL(0.38)	-	0	-
10 21 75	BDL(0.25)	-	0	-

City	Van Buren, Arkansas	Population 8,370
Water Department	Fort Smith Water Department Contact: J.B. Roach, Water Systems Superintendent Phone: 501-785-2801	
Water Source	Reservoir about 25 miles North of City -Surface waters Usage 1.5 m.g.d.	
Water Treatment	1) Coagulate with alum 2) Sand filter 3) Chlorinate 4) Storage reservoir	
Comments	Water was sampled from the faucet in the laboratory at the CAPCO A-C pipe plant at Van Buren. Due to an oversight this water had been stored for over 12 months prior to filtering	
Asbestos analysis		

Date	fpl	fpl >5μm	fibers observed	Comments
2 6 75	*40(C)	5.0	32	-

* Very small fibers >90% as unit fibrils.

Appendix H

Johns-Manville, Manville, NJ — Code G1

The Johns-Manville plant at Manville is the largest plant manufacturing asbestos products that was visited in the eastern portion of the country. The area is more rural than urban. It is a multi-product operation producing asbestos pipe, paper and textiles.

The plant is situated on the south bank of the Raritan River in the township of Manville, New Jersey about half way between Newark and Philadelphia. Since J-M employs over 2000 people this is essentially a "company town" with a total population of 13,800, and it is located on the south end of town.

The water for processing is pumped in from the Raritan River and thence to the various buildings as required. Daily usage is about 6-7 million gallons. The waste water drains through buried pipes from at least 9 buildings into a 30' pool before the River. There were no accessible sampling points for most of these operations. No information was provided on the scheduled dumping of savealls. Occasional asbestos-cement plugs cause effluent to back up into the pipe plant; the line is cleaned by dragging a heavy chain through the pipe.

The asbestos-cement pipe operation accounts for 85-90% of all the asbestos entering the settling ponds. The papermaking operation contributes about 5%. The remainder is from the textile operation. The effluent from all the buildings feeds into a 30' pool below the pipe plant and then into a burner unit where the organic wastes are burned off which introduces a major amount of CO_2 into the water. The slurry then enters a series of settling basins 750' in length, of which there are two sets. About 150' from the lower end pH control is maintained by bubbling liquid CO_2 through the effluent. At the lower end of the basins an earth dike diverts the water into another 400' ditch, at the outlet of which the effluent passes through a 14" pipe to a transfer box in the field, just south of the river. A 30' ditch guides about 20% of the effluent into the river. The other 80% enters a buried pipe and travels 3000' downstream and exits to the river below the surface near the confluence of the Millstone and Raritan Rivers. When the one set of settling basins is full the waste process water is diverted to the other set and the solid wastes are scooped out by bulldozer into a centrally-located trench 6' deep. From the trench it is loaded onto trucks and hauled to a landfill 1/2 mile distant bordering the Raritan River. It is buried and leveled to form part of a town park for Manville.

The plant was visited twice. On the first occasion (5-8 May 1975) and on the first day of the second visit (22 October 1975) the treated waste water was flowing into the river as usual. On the morning of 23 October, however, the process was changed to a closed loop for a test period. In this test all the process water was recycled and there was no discharge to the river thus all samples on the 23rd of October represent closed system conditions.

The inlet or upstream river water was sampled from the well pit in the riverside pumphouse. The used process or downstream water from all the plants was combined and fed into the series of settling basins and the first of the downstream samples was from the pipe feeing into the settling pond. A second discharge sample point was following the chlorinator (a state EPA sampling point) in the 400' ditch leading to the transfer box near the river. The transfer box was the third downstream sample location. The last two sample points were downstream River samples. The first one just below the point where the ditch enters the Raritan and the second one about 1/4 mile downstream. A downstream river sample was also obtained about 3 miles below the Raritan-Millstone river's confluence.

Consideration of the results in the attached table shows that although a substantial reduction is observed in the amphibole content of the effluent — from about 10^9 fibers per liter in the outfall at the head of the settling basin to below the detection limit (approximately 10^7 f.p.l.) at the trench leading to the discharge points, the chrysotile content is less substantially affected. Thus levels of chrysotile of the order of 10^9 f.p.l. are observed in the transfer box and in the Raritan River immediately below the first discharge point, with levels of the order of 10^7 to 10^9 f.p.l. detected ~ 3 miles downstream(D5).

On the second visit the fiber level at the river (D4) was substantially reduced during the close up test period and would presumably represent re-entrainment of settled material as there was no active discharge at that time and could therefore be expected to decrease with time.

Key to sampling points

U1	City of Manville water, sampled at drinking water faucet, Building 1.
U2	Raw river water sampled at pumphouse well pit.
D1	Outfall at head of settling basins, below burner shack.
D2	Trench below chlorinator (N.J. EPA sampling point).
D3	Transfer box in field box ~6' deep, sampled at 3' depth.
D4	Raritan River just below point where ditch from transfer box (carrying ~20% of effluent) enters river.
D5	Raritan River at South Bound Brook Bridge approximately 3 miles below Raritan - Millstone rivers' confluence.

Johns-Manville, Manville, New Jersey

TABLE H - 1

Code G1

See Legend - page 29

	5/5/75					5/7/75					5/8/75				
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1	G	BDL(0.52)	-	12	0	G	BDL(0.26)	-	7	0	G	BDL(0.5)	-	21	0
U2	G	BDL(1.3)	-	59	0	G	BDL(1.3)	-	19	0	G	BDL(1.3)	-	25	0
	G(R)	BDL(1.3)	-	59	0	G(R)	BDL(1.3)	-	19	0					
D1	I	4200(C)	872	740	53	I	12000(C)	2842	670	76	I	TNTC	$\gg 10^{11}$	1780	
		800(A)	320	740	10		1300(A)	325	25	8					
D2	I	1800(C)	313	12	115	I	990(C)	133	20	156	I	TNTC	$\gg 10^{9}$	27	
						I(R)	TNTC	$\gg 10^{9}$							
D3	I	1700(C)	330	51	108	I	850(C)	95	20	134	I	TNTC	$\gg 10^{9}$	17	
D4	I	1100(C)	124	400	71	I	1600(C)	144	35	100	I(R)	TNTC	$\gg 10^{9}$	25	
D5											G	45(C)	15	39	36

Johns-Manville, Manville, New Jersey

TABLE H - 2

Code G1

	10/22/75					10/23/75									
Location	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted
U1	G	BDL(0.25)	-	7	0	G	BDL(0.31)	-	1	0					
U2	G	BDL(0.65)	-	13	0	G	TNTC	$\gg 10^9$	42						
D1	G	TNTC	$\gg 10^{10}$	218		I	TNTC	$\gg 10^{10}$	378						
D2	G	TNTC	$\gg 10^9$	10		I	TNTC	$\gg 10^9$	14						
D3	G	TNTC	$\gg 10^9$	2		G	THL		12						
D4	G	TNTC	$\gg 10^{10}$	69		G	400(C)	31	8	89					
D5	G	TNTC	$\gg 10^9$	1		G	180(C)	15	4	35					

Appendix I

Johns-Manville, Denison, TX Code P1

The Johns-Manville operation at Dennison, Texas is a major a/c pipe operation using approximately 12,000 tons of chrysotile and 3,000 tons of crocidolite annually. PVC pipe is also manufactured at this location.

The plant is situated on the west side of Route 75, approximately 5-8 miles north of the town of Denison, Texas, and about 1 mile south of the Oklahoma border. The surroundings are rural with no other industries in the vicinity.

Water for the processing operation is pumped from the Red River to a water storage tower, thence to the process line. Used process water is discharged into one of two settling ponds. When the settling pond fills, the feed is transferred to the second pond and waste solids from the first pond are removed and dumped in a "borrow pit". The plant was visited on two occasions. On the first visit (late January-early February 1975) the overflow from the settling pond passed through a short trench to which a drip feed added hydrochloric acid to adjust pH to approximately 7. It then passed a continuous recording pH meter, over a small wier into an open ditch. This ditch travelled approximately 3/4 mile to the Red River into which it discharged at a point about 50-60 feet downstream of the intake. Discharge took place for approximately 9 hours of the day at a rate of approximately 75,000 gallons per day. On the second visit (Dec. 1975) the system was closed up with no evidence of water having been discharged to the overflow ditch for quite some time.

Samples were taken on the upstream side of the process line just below Denison Dam (approximately 1-2 miles upstream of the plant) at the Red River intake and at a hose adjacent to one of the pipe machines. Downstream samples were taken at the pipe feeding effluent to the settling pond, at the wier in the overflow ditch from the settling pond, approximately half way along the open ditch to the Red River and at the open ditch near its discharge point into the river.

The analyses of samples taken at Denison on the first visit show little reduction of the asbestos content of the effluent after the settling pond, with levels in the drainage ditch still as high as 10^9 f.p.l. The figures at the "fence line" (D4) seem to reflect weather conditions with levels below 10^6 f.p.l. on the first day, which was dry, increasing on the 2nd and 3rd days as rainfall increased. On the 3rd day the stream was carrying considerable amounts of suspended solids, appearing quite red and muddy with the red soil which had washed into it. This could be a contributing factor to the high asbestos count as a result of wash off of debris from scrap pipe in the vicinity together with re-entrainment of previously settled material. These phenomena are also the only logical explanations of the observed levels at D3 and D4 on the second visit as there was no evidence of the recent passage of water over D2.

Key to Sampling Points Table I - 1

U3	Red River at Denison Dam
U2	Red River at Johns-Manville pump intake
U1	Hose in plant, adjacent to pipe machine.
D1	Outfall from plant to settling pond - very variable flow rate.
D2	Overflow ditch from settling pond at weir where pH control is monitored.
D3	Overflow ditch, approximately midway between settling pond and Red River.
D4	Overflow ditch at Red River.

Johns-Manville, Denison, Texas

TABLE I - 1

Code P1

See Legend - page 29

	1/29/75					1/30/75					1/31/76				
Location	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted
U1	G	4.1(C)	0.63	24	26	G	4.3(C)	0.65	6	20	G	BDL(2.5)	-	10	0
U2	G	BDL(0.25)	-	24	0	G	BDL(0.5)	-	6	0	G	BDL(2.5)	-	54	0
	G	BDL(0.25)	-	23	0										
U3	G	BDL(1.0)	-	19	0						G	BDL(0.5)	-	5	0
D1						I	3900(C)	891	680	70	I	2600(C)	1252	230	81
												48(A)	42	93.33	15
D2	G	2.6(C)	0.5	7.2	21	G	0.63(C)	0	9.2	5	G	5.4(C)	2.4	9.5	43
						I	1.1(C)	0.24	9.1	9					
D3	G	1400	23	780	62	G	56	8.4	24	20	G	3300	119	125	217
	G	16	2.2	5	29										
D4	G	BDL(1.0)	-	100	0	G	8.4(C)	0	44	3	G	3700	285	468	65
	G	BDL(1.0)	-	22	0	G	45(C)	0	16	40					

Johns-Manville, Denison, Texas

TABLE I - 2

Code P1

	12/9 /75					12/10/75									
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1	G	BDL(1.3)	-	7.8	0	G	BDL(1.2)	-	4.5	0					
U2	G	BDL(0.45)	-	2.2	0	G	BDL(1.1)	-	2.2	0					
U3	G	BDL(0.47)	-	8.3	0										
D3	G	160	4.8	242.6	33	G	620	103	242.6	36					
D4	G	36	0	7.1	24	G	270	51	43.2	32					

Code: P2

Cement-Asbestos Products Company (CAPCO), Ragland, AL

The CAPCO plant is situated in a rural area one-half mile west of the village of Ragland and 15 miles from Pell City, Alabama. The main product is asbestos cement pipe.

The upstream water used for processing is from an artificial lake, (Lake Weaver) located about 1/4 mile from the plant. The used process water is discharged through a 6 ft deep trough into a concrete basin. Here the solids are removed automatically and continuously with a chain drive mechanism which feeds into a front end loader. The collected solids are transported to a landfill for burial. The discharged effluent water then passes into an earthen settling pond. On the occasion of the first visit (31 March - 2 April 1975) the discharge from the settling pond crossed an older bed of a/c waste to reach a spring-fed stream. Above the point of stream entry a second stream also entered containing discharge from a nearby cement plant. The combined stream flows into Trout Creek below Ragland and eventually joins the Coosa River.

On the occasion of the second visit (2 December 1975) the water discharged from the concrete basin into the settling pond was being recycled by being pumped uphill to an artificial lake constructed in October 1975 (Lake Weaver). Lake Weaver is above the original artifical lake, the primary source of upstream water. The secondary water from Lake Weaver was then combined with the primary lake water for use in processing. Thus, the operation in December represent a closed loop system with no discharge to natural waters.

The upstream primary water from the natural water lake was sampled in March but both primary and the secondary recycled reservoir were sampled in December.

The discharged water was sampled at the point of emergence from the plant in the 6 ft deep trough. The next downstream sampling point was the outflow from the concrete basin. In the December operation this is the water recycled to Lake Weaver. In March the outflow was discharged to a creek about 1/2 mile downstream at a point where the stream also represented discharge water from a nearby cement plant which was sampled separately. The combined discharge water was sampled once at Trout Creek, below confluence with CAPCO stream. This point was about 2-3 miles downstream.

Discussion of the results obtained at Ragland is complicated by the variations occurring in the system throughout the sampling periods. Thus on the first visit it is noted that flow below D2 was temporarily blocked by an earth dam, but that normal flow had resumed by April 2nd. One is therefore tempted to state that only the April 2nd data represent the true situation as it then existed. The interpretation is further complicated by the high ($>>10^8$) readings at D2 on April 1st which were anticipated by the original site report which mentions cleaning of the ditch below D1 with a high pressure hose on that date.

By the date of the second visit the system was effectively closed up with water from the concrete basin being pumped to Lake Weaver, an artificial lake constructed above the original artificial lake. Water from both lakes is now combined to yield the process water currently used.

Key to Sampling Points   Table J-1

U1	Artificial lake 1/4 mile above plant
U0	Lake Weaver — an artificial lake above that of U1, to which D2 effluent is now pumped
D1	Concrete trench (6' deep) just outside plant — trench deepens to 14 feet — leading to concrete basin
D2	Outflow from concrete basin from which solids are removed continuously
D3	Stream from National Cement Company above junction with CAPCO effluent
D4	CAPCO and National Cement combined effluents en route to Trout-creek.
D5	Trout creek below compliance with effluents.

Capco, Ragland, Alabama

TABLE J - 1

See Legend - page 29

Code P2

	3/31/75					4/1/75					4/2/75				
Location	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted
U1	G	BDL(0.45)	-	21	0	G	BDL(0.9)	-	21	0	G	BDL(0.36)	-	23	0
						G(R)	99(C)	14	21	55					
D1	I	TNTC	$\gg 10^{10}$	na		I	TNTC	$\gg 10^{10}$	709		I	TNTC	$\gg 10^{9}$	na	
D2	I	100(C)	34	150	29	I	TNTC	$\gg 10^{8}$	57		I	BDL(C)(1.4)	-	150	0
		67(A)	0	150	15							21(A)	16	150	17
D3	G	6.3(C)	4.2	1874	9	I	TNTC	$\gg 10^{9}$	28		G	BDL(1.1)	-	108	0
	G(R)	BDL(0.70)	-	1874	0										
D4	G	490(C)	210	104	35	I	23(C)	4.1	85	28	G	15(C)	8.2	111	11
		56(A)	0	104	4		5.9(A)	1.7	85	7		2.5(A)	0	111	2
D5	G	23(C)	3.1	25	22										

Capco, Ragland, Alabama

TABLE J - 2

Code P2

12/2/75

Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U0	G	16(C)	0*	na	13										
U1	G	2.1(A)	0	13	5										
D1	G	TNTC	$\gg 10^{10}$	1104											
	G(R)	TNTC	$\gg 10^{10}$	1104											
D2	G	210(C)	0	16	34										
		19(A)	0	16	3										
D3	G	250(C)	50	52	25										

* 100% less than 0.5µm

Cement Asbestos Products Company (CAPCO), Van Buren, AR

The CAPCO plant at Van Buren was the smallest of the asbestos cement pipe plants visited. The plant is situated on or near an industrial estate east of Van Buren and north of the Arkansas River. PVC pipe is also produced at this plant. Effluent, principally cooling water, from the pvc plant is separate from the asbestos cement process water, running directly to an open ditch running along the north side of the plant. This ditch also carries untreated sewage from the town. The ditch discharges to a lake some distance to the east of the plant; the lake in turn feeds out to the Arkansas River.

Water for the asbestos cement pipe process is obtained from a well on the site which supplies only the process lines. Effluent is discharged via a pvc pipe to a series of 3 concrete settling basins which are used in rotation. When filled these basins are emptied by mechanical shovel and the solid wastes are dumped on the site. Overflow from the settling basins is channeled through a concrete spillway to a large pond (really two ponds interconnected by a narrow channel). Any overflow from these ponds passes out through a stand pipe to an open ditch on the north side of the site. This condition of overflow would be extremely rare. At the time of the visit there had been considerable rainfall resulting in much standing water on the site, and a volume of water in the Arkansas River approximately 4 times greater than normal. The level of the ponds, however, was still about 12-18" below the level of the overflow pipe. It was claimed that overflow had occurred only twice in about 3 years and that then when this occurred the entire area was flooded with considerable unchanneled run off to the ditch. This is quite believable, and under such conditions the unchanneled run off could be expected to contain much asbestos cement waste from the primary settling pond area. To all intents and purposes this plant could reasonably be considered a closed system and therefore only one visit was made, in February 1975.

K - con't.

Samples were taken of the well water used for processing, of the pvc pipe process cooling water, of the asbestos cement process effluent to the settling tank, of the discharge leaving the concrete spillway from the primary settling tank and of the final settling pond in the vicinity of the overflow stand pipe. One sample was also taken of the Van Buren city water from a faucet within the quality control laboratory at the plant.

The only surprising feature about the results obtained at Van Buren was the high asbestos count in the cooling water from the pvc pipe process. This water runs in a concrete channel alongside the primary settling basins and the variability of the results, on the first day of sampling considered along with the adverse weather conditions at the time of sampling suggests that contamination due to run off is being experienced.

The variation in levels detected, which is particularly evident in the series of samples taken on February 5 highlights one of the major problems experienced in analyzing asbestos cement plant effluents. The cement component of the solids, if the process is working successfully, effectively coats the asbestos fibers and promotes adherence to each other leading to the formation of clumps and aggregates from which no clear positive diffraction pattern can be obtained. Under such conditions counting and measurement of fibers and their classification as asbestos becomes a very uncertain process. It is more than likely that had these samples not been run "blind" (to eliminate prejudicial judgements by the analyst) that the statement "chrysotile not present - the material resembling it is crystalline and a Ca-Mg silicate with some Fe" would have been modified to take cognizance of the presence of fibers, probably asbestos, intimately associated with a cementing matrix.

Key to Sampling Points Table K-1

U1	Well water used for process water from faucet adjacent to mixing machine
D1	Cooling water from PVC pipe line
D2	Asbestos cement pipe process effluent to settling tank
D3	Discharge at end of concrete spillway from settling tank
D4	Final pond near overflow stand pipe

Capco, Van Buren, Arkansas

TABLE K - 1

See Legend - page 29

Code P3

	2/3/75					2/4/75					2/5/75				
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1											G	BDL(4.8)	-	3	
											G(R)	BDL(1.2)	-	3	
D1	G	BDL(0.13)	-	7	0	G	TNTC	$\gg 10^9$	10		G	TNTC	$\gg 10^9$	10	
	G(R)	TNTC	$\gg 10^9$	7		G(R)*									
	G	110	58	na	42										
D2	I	TNTC	$\gg 10^9$	1080		I	3600(C)	745	760	29	**I	TNTC	$\gg 10^{10}$	843	
	I(R)	TNTC	$\gg 10^{11}$	1080			630(A)	760	760	5	**I(R)	2500(C)	395	843	38
						I(R)	TNTC	$\gg 10^{11}$	760			400(A)	200	843	6
											**I(R)	BDL(66)	-	843	0
											**I(R)	TNTC	$\gg 10^{10}$	843	
D3	I	THL		410		I	BDL(3.1)	-	206	00	I	BDL(6.97)	-	153	0
	I(R)	THL		410		I(R)	BDL(1.6)	-	206	0	I(R)	BDL(2.8)	-	153	0
	I(R)	TNTC	$\gg 10^{10}$	410							I(R)	2100(C)	140	153	45

* Fibers present, inadequate diffraction pattern; probe could not confirm - show Al and other elements in addition to Mg and Si.

** This series highlights the counting problem. The descriptions accompanying one of the TNTC samples and the BDL sample

Capco, Van Buren, Arkansas
page two

TABLE K - 1

Code P3

	2/3/75					2/4/75					2/5/75				
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
D4	G	2200(C)	175	28	138	G	5300(C)	642	28	33	I	BDL(6)	-	22	0
						G	TNTC	$\gg 10^{10}$			I(R)	48(C)	6	22	16
											I(R)	69(C)	6	22	23

** con't.

** read respectively, "heavy clumping of Ca material containing large quantities of asbestos" and "chrysotile not present - the material resembling it is crystalline and a Ca-Mg silicate with some Fe". See also accompanying discussion.

Appendix L

Certain-Teed Products, St. Louis, MO — Code P4

The Certain-Teed plant is situated on the north east side of St. Louis approximately 1/2 - 1 mile from the Mississippi River. A cement plant is adjacent to the CT plant on one side; on the other runs Maline Creek which separates CT from a residential area. Water used in the processing operations is St. Louis municipal water. The Certain-Teed plant was visited twice, the two visits probably representing the extremes in waste disposal technology.

On the first visit the facility was operating probably the most rudimentary waste disposal of any of the plants studied. Process water was pumped to large save-alls whose overflow ran through a covered channel in the plant floor, out through a concrete spillway and ditch to a small creek running through the property. This creek ditch also carries effluent from the neighboring cement plant and discharges into Maline Creek (see sketch). When the save-alls were dumped or during machine clean up the effluent was diverted and pumped to a large waste pile (variously refered to as "The White Mountain" or "Stromboli") which has been growing since the plant went into operation. Loss of water from this pile was by percolation with no obvious run off. Only the save-alls represented any type of effort at sedimentation.

Samples were taken of St. Louis municipal water from a drinking fountain adjacent to the pipe machine, from the creek from the cement plant prior to entry of the CT effluent, from the vacuum seal water discharge, from the overflow from the save-alls, from the ditch leading to the creek (combining save-all overflow and seal water), from the creek below the entry of the CT effluent and from Maline Creek downstream of the entry of the creek.

On the second visit treatment facilities for completely recirculating process water had been on stream for about 2 months. During that period difficulties had been experienced only once, when moisture from the stack gas, used to reduce pH, froze within the pipes during sub-zero weather. A description of the waste treatment follows.

Effluent, consisting of overflow from the save alls and cooling water from the vacuum seals runs through an 8" pipe and empties into a concrete trough situated several hundred feet from the pipe plant. The trough, measuring about 8' x 40', is continually swept by a travelling rake which concentrates solids at one end. This slurry is then pumped into a large tank where it is aerated by hot stack gases to reduce the pH to nearly 8.0. The clean discharge collected from the top of the tank is recirculated within the plant. Overflow from the settling basin and unused process water is periodically discharged through a 12" pipe into Maline Creek. This discharge varies from 50,000 to 140,000 gallons per day.

Samples were taken of the incoming city water at the analytical laboratory in the plant, of the overflow from the save alls where it enters the settling basin, of the treated, pH adjusted process water from the top of the pH treatment tank, of the overflow at the discharge point into Maline Creek and of Maline Creek just upstream of the discharge point.

The data recorded during the first visit show a surprising, but reasonably consistent variation on a day-to-day basis with the 11 February samples showing the highest asbestos counts. As the emission of overflow from the save alls is not constant with time, daily variations should not be unexpected, however, the magnitude of the variations - ranging from $<6 \times 10^6$ to 10^9 - 10^{10} - at the final discharge is surprising. The vacuum seal water showed a near constant asbestos level during this same period.

Although the currently used treatment plant substantially recycles the process water, there is still some periodic discharge (at D3) into Maline Creek, and asbestos has been detected immediately downstream of the discharge.

Key to Sampling Points - Table L-1

U2	Creek from cement plant above confluence with Certain-Teed effluent
D1	Overflow from save-alls, downpipe to channel in floor
D2	Vacuum seal water, pipe adjacent to D1
D3	Effluent (D1 and D2) ditch outside plant
D4	Creek below confluence of cement plant and Certain-Teed effluents
D5	Maline Creek at Riverview Drive bridge.

Certain-Teed, St. Louis, MO

TABLE L - 1

See Legend - page 29

Code P4

	2/10/75					2/11/75					2/12/75				
Location	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted
U2	G	2100(C)	900	555	42	I	BDL(11.0)	-	753	0	I	BDL(8.4)	-	322	0
	G	620(C)	50	404	62										
D1	G	TNTC	$\gg 10^{10}$	396		I	THL		338						
D2	G	64(C)	9.7	10	53	G	31(C)	18.75	1	32	G	83(C)	28	1	33
D3	G	13(C)	1.2	90	31	*no count possible, fpl $>10^8$, (C)					I	BDL(7.6)	-	248	0
D4	G	900(C)	180	182	45	I	200(C)	22.58	93.55	31	I	BDL(6.0)	-	433	0
D5											G	BDL(3.4)	-	98	0

* Sample heavily agglomerated - agglomerates are Ca - rich.

Key to Sampling Points - Table L - 2

U1	St. Louis water
D1	Overflow from save-alls
D2	Treated, pH adjusted process water from top of tank
D3	Outflow at discharge point into Maline Creek
D4	Maline Creek just upstream of discharge D3

Certain-Teed, St. Louis, MO

TABLE L - 2

See Legend - page 29

Code P4

1/15/76

Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1	G	4.9(C)	0.88	21	39										
D1	G	1800(C)	650	244	36										
D2	G	*		1	0										
D3	G	180(C)	25	41	29										
D4	G	15(C)	1.2	22	12										

* Examination difficult due to agglomeration

Appendix M

Flintkote Corporation, Ravenna, OH Code P5

The Flintkote Corporation is a major manufacturer of asbestos pipe. They also manufacture PVC pipe at this location.

The plant is situated on the north side of I-76 near its intersection with Route 44, about 2 miles south of Ravenna. It is a semi-rural area. Active wild animal life was observed in the swamp area about 1/4 mile to the rear of the plant.

The upstream water used for processing is obtained from Lake Hodgson which is 3 miles distant. The water is pumped through A/C pipe to a water tower centrally located on the Flintkote property.

The downstream waste water from processing is discharged at the rear of the main building into a concrete trough about 1 ft deep into one of two settling basins. The overflow is diverted into a natural pond. Just below the outlet of the pond the pH is adjusted using sulfuric acid and measured by a continuous recording meter just below the pond. The outfall passes into a stream which enters a swamp (1/4 mile). An A/C waste pile borders the stream following the pH adjustment point and extends several hundred yards into the swamp. Solids are probably washed into the swamp through percolation and run off but direct run off into the effluent is prevented by earth dikes separating the waste pile and stream. A seepage pond is formed at the western edge of the Flintkote property. Here water spills over a river and winds through privately owned farms for 1 - 2 miles, entering Breakneck Creek just above a bridge (Herriff Road). The creek eventually passes the town of Kent.

No data were available on flow rates. Save-alls were reportedly dumped intermittently on an unscheduled basis. The solid waste from the settling basins is carried by truck to an uncovered landfill on Flintkote property which borders the swamp.

The plant was visited twice. The first visit occurred 29 April - 2 May 1975, and the second one 11 November 1975. Waste water processing was about the same on both occasions.

M - con't.

Samples of the upstream water were taken at Lake Hodgson and also at the water tower on the Flintkote property. This water was then fed to the pipe processing plant.

The waste water discharged at the rear of the building was sampled from the cement trough close to the building. The next waste water sampling was on the outflow at the west end of the settling pond and again below the pH adjustment point. The last sampling point was at the outfall from the river below the swamp at the west end of the Flintkote property. Samples were also taken during the May visit from Breakneck Creek about 2 miles from Flintkote, below confluence with the Flintkote stream and a sample was also taken from Breakneck Creek before it joined the Flintkote stream.

The waste disposal system at Flintkote appears to effectively prevent the contamination of the local stream by asbestos. No asbestos was detected in Breakneck Creek below the Flintkote discharge while levels of the order of 10^8 fpl were detected in the weir at the fence line, approximately 1-2 miles from the point of entry to Breakneck Creek.

Key to Sampling Points Table M-1

U1	Water tower, sampled at faucet in boiler room
U2	Spring fed lake — Lake Hodgson
D1	Used process water discharge to settling basin
D2	Outfall from settling pond
D3	Outfall from pH adjustment basin
D4	Outfall at weir below swamp
D5	Breakneck creek below confluence with Flintkote stream
D6	Breakneck creek above confluence with Flintkote stream

Flintkote, Ravenna, Ohio

TABLE M - 1

Code P5

See Legend - page 29

	4/30/75					5/1/75					5/2/75				
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1	G	BDL(0.7)	-	18	0	G	BDL(1.3)	-	24	0	G	BDL(0.7)	-	34	0
U2	G	BDL(0.79)	-	14	0	G	BDL(0.5)	-	17	0	G	BDL(0.55)	-	17	0
	G(R)	BDL(0.79)	-	14	0										
D1	I	TNTC	$\gg 10^{10}$	169		I	TNTC	$\gg 10^{10}$	250						
D2	I	30(C)	2	34	30	I	BDL(0.23)*	-	42	0	I	BDL(0.18)*	-	56	0
D3	I	190(C)	7.3	27	26	I	1200(C)	462	93	39	I	23(C)	3.8	28	18
							480(C)	256	93	15					
D4	I	BDL(0.38)	-	26	0	I	18(C)	45	15	28	I	31(C)	0	29	24

* Agglomeration due to Ca containing compound noted.

Flintkote, Ravenna, Ohio
page two

TABLE M-1, cont.

Code P5

								5/1/75					5/2/75		
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
D5						G	BDL(1.0)	-	23	0	G	BDL(0.63)	-	23	0
											G	BDL(1.3)	-	26	0
											G(R)	BDL(1.3)	-	26	0
D6											G	BDL(1.3)	-	18	0
											G	BDL(0.63)	-	17	0
			11/7/75												
U2	G	220(C)	67	13	33										
	G(R)	110(C)	17	13	53										
D1	G	2400(C)	83	673	29										
D2	I	180(C)	23	38	55										
D3	I	140(C)	10	6	27										
		20(A)	15		4										
D4	I	12(C)	2.1	12	23										

Appendix N

National Gypsum Company, New Orleans, LA Code S1

The National Gypsum Company is a medium size company manufacturing asbestos-cement sheet . The plant is situated in an industrial area bordering the Mississippi River levee within the city of New Orleans.

The origin of the upstream water used in plant operations is the city water department.

The A/C waste process water is treated with a polyelectrolyte flocculent and fed to a 10,000 gallon settling tank. The clarified effluent is mixed with vacuum seal water and partially recycled for processing. Plans call for total recycling of process water and so far are partially completed. There was no pH control but the treatment effected almost complete removal of solids. Escape of solids in small amounts appears possible only during the dumping of save-alls (10-30 min each day) when excess solids may sweep over the spillway of the concrete pits and into the sewer. The A/C solids are allowed to settle in the concrete pits on the outside of the building and the overflow from these passes down a shallow trench beside the building into a stone sewer. In the sewer the effluent flows north to the Broad and Calliope pumping station and then through 15 ft pipes into Lake Pontchartrain. The solid waste is shoveled into metal bins and removed for landfill burial.

The plant was visited on two occasions. The first visit was on 25-27 March 1975, and the second on 4-5 December 1975. Some of the used and clarified process water was recycled in April, and further progress in this direction had been made as observed in the December visit.

The upstream city water was sampled inside the building from one of the drinking fountains. A sample of the Mississippi river was taken at a parkside location where there was access to the river. The river was near flood stage at the time. At another park a water sample was taken of Lake Pontchartrain.

The first downstream sample representing the first effluent processing water was taken inside the plant at the valve outlet from the bottom of save-all number 1. The next sample point was the outfall from the plant leading from the concrete collecting pit. The best waste effluent sampling point was the overflow from the settling tanks where the water enters the storm drain of the sewer system at the north end of the building. The vacuum seal water was sampled inside the plant. The excess vacuum seal water was periodically vented into the concrete pits.

The overflow from the settling tanks appears to show some considerable variation, BDL - $>10^9$. In view of the low frequency of dumping of the save-alls (10-30 min each day) it is possible that this may account for these observed variations.

Key to Sampling Points Table N-1

U1	New Orleans municipal water supply
U2	Mississippi River
D1	Valve at bottom of savealls
D2	First out-fall from plant
D3	Vacuum seal water-sampled in plant
D4	Overflow from settling ranks to storms drain
D5	Lake Ponchartrain
D6	Tap water, Quality Inn

National Gypsum, New Orleans, Louisiana

TABLE N - 1

See Legend - page 29

Code S1

		3/25/75					3/26/75					3/27/75			
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1	G	BDL(1.1)	-	42	0	G	0.88(C)	0.13	10	7	G	BDL(1.3)	-	17	0
						G(R)	BDL(0.13)	-	10	0					
D2	I	TNTC	$\gg 10^9$	83		I	BDL(0.43)*	-	70	0	I	TNTC	$\gg 10^9$	89	
D3	G	BDL(0.13)*	-	15	0	G	6.4(C)	1.26	6	51	G	BDL(0.13)*	-	23	0
D4	I	TNTC	$\gg 10^9$	71		I	BDL(0.48)*	-	91	0	I	BDL(0.63)*	-	71	0
											G	BDL(0.63)	-	70	0
		3/29/75													
U2	G	BDL(1.0)	-	367	0										
	G(R)	BDL(1.0)	-	367	0										
D5	G	BDL(0.9)	-	50	0										
D6	G	BDL(0.14)	-	17	0										

* filmed and agglomerated sample - no positive identification of fibers as asbestos

National Gypsum, New Orleans, Louisiana

TABLE N - 2

Code S1

	12/4/75					12/5/75									
Location	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted
U1	G	BDL(0.5)	-	1	0	G	TNTC	$\gg 10^9$	0.1						
D1	G	TNTC	$\gg 10^{11}$	8494											
D2	I	*74(C)	5.3	24	28	I	950(C)	79	35	60					
D4	I	98(C)	19	20	37	I	1200(C)	343	77	49					

* Counting difficult due to agglomeration

Appendix O

GAF Corporation, St. Louis, MO   Code S2

The GAF plant is situated on Riverview Drive in the Northeast part of St. Louis and is approximately 1/4 mile from the Mississippi River. The plant is adjacent to a cement plant and not far removed from the CertainTeed AC pipe plant.

Water used in the processing operations is St. Louis municipal water. Effluent leaves the plant via a concrete trench to a pump house, and is pumped to the top of a large waste pile.

The waste pile has at least 2 main basins - as one fills the feed is transferred to the other. The first then percolates through and, when empty the walls are scooped out higher ready for the next period of use. There was no evidence of any overflow but presumably this could occur if the wall was to break.

Loss of water from the resulting lagoon is by percolation with no identifiable run off or overflow. The waste pile is adjacent to Maline Creek; any run off to this creek would be downstream of discharges from the cement plant and from Certain Teed's AC pipe operation.

The plant was visited on two occasions, February 1975 and January 1976. Samples were taken of the St. Louis Municipal water, from a faucet near the process line and of the effluent at the point where the concrete trench emerges from the building, of the seal water where it spills into the trench and of Maline Creek at Riverview Bridge.

Samples taken at the trench on 2.10.75 smelled strongly of kerosene: a mixture of No. 2 fuel oil and animal fat which is used in the process may have leaked into the effluent. Samples taken at the same point on 2.11.75 prior to approximately 11:00 a.m. do not reflect normal running conditions due to a pump failure resulting in backing up the concrete trench to a depth of approximately 18" - 3 times the normal depth.

Key to Sampling Sites Table O - 1

U1	St. Louis water, faucet near process line
D1	Concrete trench leading to pump, just outside plant
D2	Water from seals at point where it spills into trench
D3	Maline creek at Riverview Drive bridge, common sampling point with CertainTeed (D5), St. Louis

GAF Corporation,
St. Louis, Missouri

TABLE O - 1

See Legend - page 29

Code S2

	2/10/75					2/11/75					2/12/75				
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	
U1	G	0.08(C)	0	2	1	G	0.16(C)	0	2	1	G	BDL(0.28)	-	2	0
		1.5(A)	0.63	2	19		4.7(A)	1.9	2	30					
	G	BDL(0.13)	-	2.0	0	G	BDL(0.13)	-	2.0	0	G	BDL(0.45)	-	2.0	0
D1	G	TNTC	$\gg 10^{10}$	432		I	TNTC	$\gg 10^{10}$	382			TNTC	$\gg 10^{11}$	660	
	G	TNTC	$\gg 10^{10}$	330											
D2	G	220(C)	145	500	35						G	36(C)	3.3	8	43
											G	9.5(C)	2.1	8	37
D3											G	BDL(3.4)	-	98	0

GAF Corporation,
St. Louis, Missouri

TABLE O - 2

Code S2

1/13/76

Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1	G	BDL(0.25)	-	15	0										
D1	I	TNTC	$\gg 10^{11}$	632											
D2	G	170(C)	9.6	9	53										
D3	G	1700(C)	164	41	52										

Appendix P

Johns-Manville Corporation, Nashua, NH Code S3

The Johns-Manville Corporation at Nashua is a medium-sized manufacturing plant producing asbestos board and laboratory table tops. It is located on the edge of an urban area of Nashua. The Nashua River flows past at the rear of the property about 1/4 mile from the office.

The plant obtains its upstream supply of process water from the city of Nashua.

There is a set of four holding tanks for receiving the waste process water. After settling the solids the clarified water is recycled. At the time of the first visit on 23 July 1975 progress had been made toward a closed system. The amount of clarified effluent being discharged to the Nashua River was about 20,000 - 25,000 gallons per day. This was usually discharged about once per shift, when the pump was activated for about 1/2 hour. This same pipe discharges continuously a small amount of boiler condensate, cooling waste and one single toilet. At the second visit on 14 October 1975, the waste discharge had been reduced to about 1/2 that of the discharge in July.

The city water was sampled at a drinking fountain in the plant. The waste water was sampled from the discharge pipe at the riverside. Two Nashua River upstream samples were taken at 50 and 700 yds upstream in July and 10 and 50 yds upstream in October. Two downstream river samples were also taken at 50 and 150 yds during the July visit and 30 yds and 100 yds downstream during the October visit. The Nashua River enters the Merrimac River about 300 yds downstream.

The Nashua River was at a higher stage by about 2 ft from that observed in July and flowing more swiftly, probably due to about 4 days of rain before our visit.

Although Nashua was nominally a closed system some discharge on an intermittent basis took place at levels of about $10^9 - 10^{10}$ fpl. This discharge may be reflected in the detection of asbestos downstream from the plant. It should be noted, however, that higher levels of chrysotile are detected upstream from the discharge on 7/23/75 and approximately equal levels on 10/14/75. At present no source has been identified for this upstream asbestos.

Key to Sampling Points Table P-1

U1	Nashua city water
U2	Nashua river 700 yds upstream of J. M. Plant
U3	Nashua river about 50 yds upstream of J. M. Plant
D1	Discharge to Nashua river
D2	Nashua river about 30 yds downstream from point of entry of D1
D3	Nashua river about 100 yds downstream from point of entry of D1

Johns-Manville, Nashua, New Hampshire

TABLE P - 1

See Legend - page 29

Code S3

	7/23/75					10/14/75									
Location	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted
U1						G	BDL(0.38)	-	13	0					
						G(R)	BDL(0.38)	-	13	0					
U2	G	2200(C)	943	17	35	G	8.8(C)	1.3	1.4	7					
U3	G	170(C)	50	654	27	G	2.5(C)	1.25	10	2					
						G(R)	BDL(1.3)	-	10	0					
D1	G	BDL(1.6)*	-	210	0	G	TNTC(C)	$\gg 10^{10}$	86						
	G(R)	TNTC(C)	$\gg 10^{8}$	210		G	4000	533	76	45					
D2	G	150(C)	50	14	24										
D3	G	340(C)	66	8	41	G	3.1(C)	0	2	3					

* Many inorganic fibers noted; agglomeration common; could not positively identify asbestos.

Appendix Q

Nicolet Industries, Ambler, PA Code S4

The Nicolet plant is a small plant producing asbestos cement sheet and located on the south edge of the town of Ambler. Water for processing is pumped from Wissahickon Creek to which effluent, at the rate of about 50,000 gallons per 8 hr day, is returned.

The water pumped from the creek is fed to a reservoir approximately 2 blocks west of the plant, thence to a large tank inside the plant building. Both the reservoir and the tank were sampled. After process use, and loaded with solids, the water is discharged into one of three drop out basins whose overflow is into one or more of four settling ponds, separated from each other by filter beds of porous slag and usable either singly or in series. Settled solids from the drop out basins are pumped to a nearby waste hill. Overflow from the final settling pond passes through a porous slag filter bed to a small creek and on down to Wissahickon Creek. Samples of the effluent were taken at the discharge into the drop out basin, the drop out basin overflow to the settling pond and the final outlet to the creek.

Although Nicolet had originally been described as a totally closed system some effluent is returned to Wissahickon Creek. Visually, this effluent appears cleaner than the incoming water. The asbestos content, however, is variable in the range 10^8 to 10^{10} fpl. It should be noted, however, that asbestos of the order of 10^8 to 10^9 fpl is apparently already present in Wissahickon Creek prior to the addition of the Nicolet material which seems to have little impact on the total asbestos content.

Key to Sampling Points Table Q - 1

U1	Storage tank in building - water pumped from Wissahickon Creek
D1	Process water discharge to "drop out" basins
D2	Overflow from drop out basin to settling pond
D3	Outlet from settling pond to Wissahickon Creek

Nicolet Industries, Ambler, Pennsylvania

TABLE Q - 1
See Legend - page 29

Code S4

	5/12/75					5/13/75					5/14/75				
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1	G	78(C)	23	10	31	G	290(C)	31	19	37					
D1	I	30,000(C)	11490	890	47	I	TNTC(C)	$\gg 10^{12}$	3570		I	TNTC(C)	$\gg 10^{11}$	1238	
D2	I	2,100(C)	228	60	46	I	TNTC(C)	$\gg 10^{10}$	105		I	TNTC(C)	$\gg 10^{11}$	1368	
											I(R)	TNTC(C)	$\gg 10^{11}$	1368	
D3	I	150(C)	39	5	36	I	TNTC(C)	$\gg 10^{9}$	13		I	THL		18	
	I(R)	BDL(0.5)	-	5	0										
								10/24/75							
D1						I	TNTC	$\gg 10^{11}$	2304						
D2						I	2400(C)	120	2	40					
D3						I	640(C)	16	1	40					

Appendix R

Johns-Manville Corporation, North Billerica, MA Code S5

The Johns-Manville Corporation is a medium sized manufacturing company producing asbestos board and table tops. It is located just east of Rte 3, a few miles south of Lowell, Massachusetts on the northeast edge of North Billerica in Iron Horse Industrial Park.

The upstream water supply is obtained from the town of Billerica. The downstream waste process water is pumped out to a large outdoor settling pond which is diked to a height of 6-8 ft above ground. The settling pond has no outlet and constitutes a closed system. The high retaining walls above ground were constructed because of the high water table.

The plant also has storm sewers for rain which can carry a little soil drainage to the creek which crosses the rear of the property. The creek empties into a marshy area about 2 miles away and eventually empties into the Merrimac River.

The plant was visited once on 24 July 1976.

The city upstream water was sampled inside the plant from a drinking fountain. The downstream waste discharged from the pipe was sampled as it was flowing into the settling pond. One upstream creek sample was obtained from a bridge on High Street. Two downstream creek samples were obtained, one about 1/4 mile and the second about 1 mile distant.

The Johns-Manville operation at Billerica constitutes a closed sample having no impact on asbestos levels in the nearby creek which carries soil drainage from the property. The two observations of amosite asbestos downstream from the plant each represent only 3 fibers detected, and as such cannot be regarded as statistically significant.

Key to Sampling Points - Table R-1

U1	City water
U2	Creek carrying storm sewer drainage-upstream of plant
D1	Settling pond
D2	Creek carrying storm sewer drainage. About 1/4 mile downstream of plant
D3	Creek carrying storm sewer drainage. About 1 mile downstream of plant

Johns-Manville, Billerica, Massachusetts

7/24/75

TABLE R - 1

See Legend - page 29

Code S5

Location	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted
U1	G	BDL(0.17)	-	na	0										
U2	G	BDL(4.4)	-	16	0										
	G	BDL(6.3)	-	8	0										
D1	G	5800(A)*	3026	257	46										
	G	8700(A)	2342	83	52										
D2	G	BDL(1.3)	-	na	0										
	G	3.4(A)*	3.4	6	3										
D3	G	BDL(1.3)	-	na	0										
	G(R)	BDL(1.3)	-	na	0										
	G	3.8(A)*	2.5	na	3										

* Amphibole identified as amosite

Appendix S

Johns-Manville Products Corporation, Tilton, NH Code R1

The Johns-Manville Corporation is a smaller J-M plant which produces both asbestos paper and mill board for the construction industry. It is located about 1/2 mile south of Rte 3 about 5 miles east of Franklin, New Hampshire. The 12 mile stretch between Franklin and Laconia has many resort areas on small lakes and is semi-rural.

The upstream water is pumped in from the Minnepesaukee River. This river is in turn fed by the Minnepesaukee Lake about 1/4 mile away. The inlet water is screened and treated to remove about half of the total solids and some iron before use as process water. It is then fed to the inlet process line. A separate well supplies drinking water and the sewage goes to a sanitary deep well.

The used process water from the mill board operation was centrifugally separated and the liquid recycled. This was also done with the waste water from the paper operation. The unused waste water from both units were then combined, flocculent was added and then fed to the Dorr settling tank. The clarified overflow from the Dorr tank was then piped about 400-500 ft to the discharge point on the Minnepeasaukee River about 100 yards downstream from the upstream intake. The Dorr tank effluent was combined with outlet boiler condensate and cooling water.

The bottoms or sludge from clarifying the process waste of both paper and mill board operations is dumped intermittently and pumped into a large closed system pond about 50 yards wide by 400-500 yards long. The pond is intermittently scooped out and the waste asbestos disposed of in a buried land fill operation.

Upstream samples were taken of the raw river water and the clarified water actually used for processing.

The only practical sampling point for the used process water was following the combined streams of both operations located in the basement of the manufacturing building. The overflow from the Dorr tank was sampled at the

Key to Sampling Points - Table S-1

U1	Inlet process water from Minnepesaukee River
U2	Inlet process water after screening and processing
D1	Combined paper and millboard effluent to Dorr tank
D2	Clarified effluent from Dorr tank
D3	"Bottoms" sludge from centrifugal separator
D4	Combined Dorr tank effluent, boiler condensate and cooling water to Minnepesaukee River

Johns-Manville, Tilton,
New Hampshire

TABLE S - 1

See Legend - page 29

Code R1

	7/21/75					7/22/75					7/23/75				
Location	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted
U1	G	BDL(0.56)	-	3	0	G	32	36-59	10	41	G	TNTC	$\gg 10^{9}$	53	
	G(R)	BDL(0.63)	-	3	0										
U2	G	BDL(1.3)	-	na	0	G	3.8	16-67	14	6	G	42	1.4	na	30
D1	G	TNTC	$\gg 10^{10}$	124		I	TNTC	$\gg 10^{11}$	382		I	TNTC	$\gg 10^{11}$	100	
	G	TNTC	$\gg 10^{10}$	248											
D2	G	TNTC	$\gg 10^{9}$	1		I	TNTC	$\gg 10^{9}$	9		I	TNTC	$\gg 10^{10}$	na	
	G	1600	235	1	102										
D3						G	TNTC	$\gg 10^{10}$	134						
D4						G	TNTC	$\gg 10^{10}$	9						
						G(R)	TNTC	$\gg 10^{10}$	9						

Johns-Manville, Tilton, New Hampshire

TABLE S - 2

Code R1

		10/15/75					10/16/75								
Location	**Type**	**f.p.l.**	**>5µm**	**tss mg/l**	**fibers counted**	**Type**	**f.p.l.**	**>5µm**	**tss mg/l**	**fibers counted**	**Type**	**f.p.l.**	**>5µm**	**tss mg/l**	**fibers counted**
U1	G	BDL(0.45)	-	8	0	G	9.9	3.4	10	26					
U2	G	3.1	0	9	10	G	6.0	1.3	15	13					
D1	G	TNTC	$\gg 10^{10}$	314		I	TNTC	$\gg 10^{10}$	410						
D2	I	TNTC	$\gg 10^{9}$	1		I	TNTC	$\gg 10^{9}$	4						
D3	G	TNTC	$\gg 10^{11}$	1137											
	G(R)	TNTC	$\gg 10^{11}$	1137											
D4	G	TNTC	$\gg 10^{9}$	3		G	TNTC	$\gg 10^{9}$	7						

Appendix T

Johns-Manville, Pittsburg, CA Code R2

The Johns-Manville plant is situated in a highly industrialized area, about 2 to 3 blocks south of the San Joaquin estuary, from which the plant derives the water used in processing. Both asbestos paper and sheet are manufactured at this plant, from which the effluent is fed to the local sewer system. Samples were taken of the incoming river water at the center vacuum pump of number 2 machine, and at the cooling drums. The effluent was sampled at the flow rate flume in the sewer. A sample of city water was collected from a faucet in the restroom.

No asbestos fibers were detected in either the city water or river water samples. Levels of the order of 10^9 to 10^{10} fpl were detected at the sewer flume.

Key to Sampling Points Table T-1

U1	Municipal water - faucet in restroom
U2	River water at center vacuum pump No. 2 machine
U3	River water at cooling drums
D1	Effluent at sewer flowrate flume

Johns-Manville, Pittsburg, California

TABLE T - 1

See Legend - page 29

Code R2

	3/4/75					3/5/75									
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1	G	BDL(0.89)	-	10	0										
U2	G	BDL(6.3)	-	64	0	G	BDL(6.3)	-	67	0					
						G	BDL(6.3)	-	67	0					
U3	G	BDL(6.3)	-	63	0	G	BDL(6.3)	-	68	0					
						G	BDL(6.3)	-	77	0					
D1	I	8300(C)	3269	270	33	I	1300(C)	144	110	36					
	I(R)	8800(C)	3200	270	55	I(R)	800(C)	175	110	32					

Appendix U

Armstrong Cork Company, Fulton, NY Code R3

Armstrong Cork is a major manufacturer of gasketing, backing material for floor tile and fill for cooling towers. The plant is located about two miles north of Fulton, New York on Rte 57, on the east side of the Oswego River and is semi-rural.

The upstream water supply is pumped in from the Oswego River at a normal rate of about 4 million gallons per day. During the visit (29-31 October 1975) they were using about 3 million gallons per day for processing.

The downstream or waste process water is discharged to a slurry pump house a few hundred feet from the plant and from here about 1/4 mile to the waste water treatment plant. The treatment plant provides three stages of treatment. The waste is first pumped into one of three 'drop-out' tanks in a housed building. The tanks are continuously dredged to remove the heavier asbestos waste. The overflow from these tanks is fed to either one of two outdoor aeration basins for oxidation of organics and then to one or both of the Dorr-type clarifiers before being discharged to the Oswego River about 1/4 mile downstream from the intake. The Oswego River empties into Lake Ontario about 10-12 miles to the north. The waste asbestos is hauled away to disposal grounds.

The upstream water was sampled at the riverside pump house. The combined discharge was sampled a a slurry pumphouse located a short distance north of the inlet water pump house. The outflow from the 'drop out' tanks was sampled regularly and then the final effluent following the clarifiers before being fed back into the Oswego River. Two more samples were taken from the river at points of access. The first of these was at a point about 1/4 mile downstream and the next one was about 3-1/2 miles downstream near the town of Minetto.

Although the sedimentation and clarifier systems at Fulton do effect a considerable reduction in the fiber content of the effluent, dropping it from about 10^{11} - 10^{12} fpl to approximately 10^{8} - to 10^{9} fpl, this latter level is being conveyed to the Oswego River. Surprisingly, however, fiber levels detected downstream of

U - con't.

the Armstrong effluent do not show a significantly higher asbestos content than that of the incoming water (10^7 to 10^8 fpl).

Key to Sampling Points Table U -1

U1	Oswego River at pumphouse
D1	Discharge at slurry pump house
D2	Outflow from dropout tank
D3	Final effluent from clarifiers to Oswego River
D4	Oswego River approximately 1/4 mile downstream of effluent
D5	Oswego River approximately 3 1/2 miles downstream of effluent

Armstrong, Fulton, New York

TABLE U - 1

Code R3

See Legend - page 29

	10/29/75					10/30/75					10/31/75				
Location	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted
U1	I	14(C)	7.6	2	11	I	480(C)	96	2	30	I	BDL(0.5)	-	1	0
	I(R)	BDL(1.3)	-	2	0										
D1	I	TNTC	$\gg 10^{12}$	392		I	TNTC	$\gg 10^{12}$	2736		I	65000(C)	12682	440	41
D2	I	11000(C)	1753	16	69	I	5900(C)	717	80	74	I	TNTC	$\gg 10^{10}$	9	
						I(R)	4900(C)	445	80	55					
D3	I	800(C)	64	9	50	I	1700(C)	63	6	54	I	4800(C)	398	38	121
											I(R)	1300(C)	0	38	61
D4						G	180(C)	17	1	32					
D5						G	41(C)	14	0.1	33					

Appendix V

GAF Corporation, Erie, PA. Code R4

GAF is a major manufacturer of asbestos paper and millboard products. The plant is located near the downtown area of Erie, about 2 miles from the shore of Lake Erie.

The upstream water supply, untreated Lake Erie water is pumped into the plant to a small reservoir on the roof of the plant. At times city water is used to supplement the untreated water but its use is limited because of economics. The Lake Erie water is then led down to the processing units.

The downstream waste process water from both paper and millboard units is separately treated. Each unit uses a pair of gravity settling tanks of about 10,000 gallons each. The clarified effluent then goes out to the city sewer system. The save-alls are dumped every 20-90 minutes to a common asbestos sludge reservoir from which the waste is loaded onto trucks and hauled away. There is another stream of shower wash water used in the paper operation. This water is mostly steam condensate and is fed into the sewer along with the clarified effluent.

Upstream sampling was done for both the city water and the untreated Lake Erie water, the untreated water at the roof reservoir and the city water from a drinking fountain.

The plant was visited twice, the first time on 8 and 9 July 1975, and the second time on 6 November 1975. Processing conditions were about the same on both visits.

The downstream sample of waste from the millboard unit was obtained on the roof at the point of being discharged into the gravity settling tank and the clarified effluent was sampled at a pit just below ground level, just before entering the sewer. The effluent from the paper unit was also pumped up to a roof line pipe feeding into the gravity settling tank where it was sampled. The clarified effluent and the steam condensate used to wash the paper were sampled

V - con't.

in the building basement before being fed into the sewer.

Although clarification has led to a reduction of about 2 orders of magnitude in the number of fibers present, all three effluents, from the paper machine, from the millboard machine and from the shower wash water used in the paper process show asbestos fibers levels in the range 10^8 to 10^{10} fibers per liter being discharged to the sewer system.

Key to Sampling Points Table V - 1

U1	Lake Erie water-untreated
U2	City water
D1	Effluent from millboard machine to settling tanks
D2	Effluent from paper machine to settling tanks
D3	Clarified effluent from paper process to sewer
D4	Shower wash water from paper process to sewer
D5	Clarified effluent from millboard machine to sewer

GAF Corporation,
Erie, Pennsylvania

TABLE V - 1

See Legend - page 29

Code R4

	7/8/75					7/9/75					11/6/75				
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1	G	BDL(1.3)	-	10	0	G	9.9(C)	1.2	8	8	G	160(C)	28	8	34
	G(R)	2.5(C)	0	10	2										
U2	G	BDL(0.16)	-	1	0	G	BDL(0.39)	-	na	0	G	BDL(0.13)	-	10	0
						G(R)	3.1(C)	0.8	na	8					
D1	G	TNTC	$\gg 10^{12}$	3470		G	TNTC	$\gg 10^{12}$	2360		G	TNTC	$\gg 10^{12}$	4308	
D2	G	TNTC	$\gg 10^{12}$	3191		G	TNTC	$\gg 10^{11}$	3088		G	TNTC	$\gg 10^{11}$	4386	
D3	I	TNTC	$\gg 10^{9}$	17		I	560(C)	112	6	105	I	TNTC	$\gg 10^{10}$	92	
D4	G	TNTC	$\gg 10^{10}$	160		G	TNTC	$\gg 10^{10}$	186		G	TNTC	$\gg 10^{10}$	320	
D5	I	450(C)	59	6	108	I	TNTC	$\gg 10^{9}$	15		I	TNTC	$\gg 10^{10}$	203	
											I(R)	TNTC	$\gg 10^{10}$		

Appendix W

GAF Corporation, Whitehall, PA Code R5

GAF is a major manufacturer of asbestos paper and flooring. The plant is situated on the west side of the Lehigh River about a mile or two north of Rte 22 and just north of the city of Allentown. It is an industrial urban area.

The upstream water source is GAF's own well located adjacent to the waste water treatment unit. The well water is pumped up and subsequently pressurized and fed to the processing units inside the buildings. We were excluded from the manufacturing building for security reasons and no information on water useage or processing was given.

The downstream waste water from the different types of operation are combined and fed to the Dorr-type clarifier. No flocculents or additives are used to aid precipitation of solids. The warm effluent is then pumped through a heat exchanger to a 15" outlet pipe located near the bottom of the river. Both inlet and outlet clarifier samples were collected from wells in the adjacent control room. A gate in the fence was unlocked so we could observe the path of the pipe at the point of entry into the river and also allow for a single upstream sample of the Lehigh River. In general the amount of solids appeared low going into the clarifier and much lower still going out to the river.

The plant was visited on two occasions. The first visit was made 19-21 May 1975. On 20 May it was apparent that the clarifier was upset for 2 hours from 10 A.M. to 12 Noon and solids were discharging into the river. The second visit was made on 27-28 October 1975. On this occasion the clarifier was operating under normal conditions with no change in the processing set-up as utilized in May.

Virtually all the downstream samples analyzed were too numerous to count representing asbestos levels in the 10^9 to 10^{12} ranges. Clarification had little apparent effect on the asbestos content of the effluent. The sample taken from the Lehigh River however, also showed a high asbestos count, $>10^{12}$ fpl, upstream of the GAF effluent. The source of this asbestos is not known.

Key to Sampling Points Table W - 1

U1	Well water
D1	Plant discharge to bottom of clarifier
D2	Output from top of clarifier tank to Lehigh River
D3	Lehigh River

GAF Corporation,
Whitehall, Pennsylvania

TABLE W - 1

See Legend - page 29

Code R5

	5/19/75					5/20/75					5/21/75				
Location	Type	f.p.l.	$>5\mu m$	tss mg/l	fibers counted	Type	f.p.l.	$>5\mu m$	tss mg/l	fibers counted	Type	f.p.l.	$>5\mu m$	tss mg/l	fibers counted
D1	I	TNTC	$\gg 10^{10}$	79		I	TNTC	$\gg 10^{10}$	189		I	TNTC	$\gg 10^{10}$	74	
						I(R)	TNTC	$\gg 10^{10}$	189		I(R)	TNTC	$\gg 10^{10}$	74	
						G	TNTC	$\gg 10^{10}$	175						
						G	TNTC	$\gg 10^{10}$	258						
						G(R)	8600(C)	207	258	108					
						G	TNTC	$\gg 10^{10}$	512						
						G	TNTC	$\gg 10^{10}$	326						
D2	I	TNTC	$\gg 10^{9}$	29		I	TNTC	$\gg 10^{10}$	39		I	TNTC	$\gg 10^{9}$	16	
						G	TNTC	$\gg 10^{9}$	20						
						G	TNTC	$\gg 10^{10}$	170						
						G	TNTC	$\gg 10^{9}$	25						
						G	TNTC	$\gg 10^{9}$	23						

GAF Corporation,
Whitehall, Pennsylvania

TABLE W - 2

See Legend - page 29

Code R5

	10/27/75					10/28/75									
Location	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted
U1	G	BDL(0.13)	-	10	0	G	3.6(C)	1.2	17	29					
D1	I	TNTC	$\gg 10^{10}$	76		I	TNTC	$\gg 10^{12}$	1160						
D2	I	TNTC	$\gg 10^{9}$	6		I	2600(C)	333	1	164					
D3	G	TNTC	$\gg 10^{12}$	7902											

Appendix X

Hollingsworth-Vose Corporation, East Walpole, MA Code R6

Hollingsworth-Vose is one of the smaller asbestos companies producing asbestos paper and cellulosic paper stock for suppling small gasket and specialty products manufacturers. The asbestos paper machine operates about 30% of the time. The plant is located on the edge of South Walpole, a suburban area on the Neponset River.

The upstream water originates from the Neponset River. The river water is forced through a sand filter bed before use as process water.

The waste process water from the asbestos paper machine goes down to the basement level where it is subsequently blended with the waste water from the cellulose paper machine. The combined streams are then sent out to the disposal flume where other plant wastes and sewage also join the outflow. The combined waste is discharged to the Walpole sewer system, thence to the Boston Metropolitan District Sewage System at a rate of 200,000-300,000 gallons per day. The sewage outlet is on the bottom of the Bay area, some distance from shore.

The plant was visited on two occasions. The first visit was made 12-13 August 1975. The river water was sampled directly at the rear of the plant. The actual process water following the sand filter bed was sampled inside the plant at an access well. Some slime was noted to be present on the first occasion in August but much less was present in the October sampling.

The waste process water was sampled in a basement well before mixing with the cellulose paper waste and then at the disposal flume just prior to being pumped into the sewer system.

Key to Sampling Points Table X - 1

U1	Process water from Neponset River
U2	Process water after sand filter
D1	Waste process water from asbestos paper machine
D2	Combined washes from asbestos and cellulose paper machine

Hollingsworth and Vose Company,
East Walpole, Massachusetts

TABLE X - 1

See Legend - page 29

Code R6

	8/12/75					8/13/75					10/17/75				
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1	G	BDL(1.0)	-	3	0	G	BDL(0.1)	-	1	0	G	72(C)	33	9	43
						G	BDL(2.1)	-	1	0					
U2	G	BDL(0.63)	-	na	0	G	BDL(0.63)	-	na	0	G	BDL(0.63)	-	11	0
	G(R)	BDL(0.63)	-	na	0	G	BDL(0.63)	-	13	0					
	G(R)	2.5(C)	0	na	4	G(R)	BDL(0.63)	-	13	0					
D1	I	78000(C)	37744	312	31	I	8000	2106	68	38	I	3000(C)	1166	58	36
D2	I	840(C)	368	4800	16	I	BDL(63.0)	-	223	0	I	2500(C)	1286	8	35

Appendix Y

GAF Corporation, Erie, PA Code T1

This GAF plant is a manufacturer of asphalt roofing only and uses no asbestos. It is located on the shore of Lake Erie and is within two miles of the business center of the city of Erie.

The plant obtains its upstream water used for processing from the city of Erie. The downstream waste process is fed to a closed system settling pond and the clarified water recycled for use in processing. There were no discharged wastes to the lake or sewer system

Since the plant used no asbestos and was operating a closed system only one visit was made, on 10 July 1975. A sample of the city water had been previously collected at the other GAF plant (R-4) so only one effluent sample was collected of the process water being discharged to the settling pond and a sample of the clarified water at a quiescent portion of the pond.

Key to Sampling Points   Table Y-1

D1	Feed to settling pond
D2	Settling pond water

GAF Corporation,
Erie, Pennsylvania

TABLE Y - 1

See Legend - page 29

7/10/75

Code

Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
D1						G	BDL(1.3)	-	61	0					
D2						G*	BDL(0.25)	-	65	0					

* Notes fibrous particles with hexagonal or pseudo hexagonal diffraction pattern, variable ratios of Si, Mg and Fe

Appendix Z

Armstrong Cork Company, Kankakee, IL

Code T2

Armstrong Cork is located in an industrialized area in northern Kankakee, and manufactures asbestos-containing floor tile.

Well water as well as city water is used in processing the tile. The well water is used once to cool the continuous sheet of tile as it is formed, then it is discarded, passing to a settling tank equipped with baffles and then travelling approximately 100 yards to Soldiers Creek which empties into the Kankakee River. The city water is used mainly for cooling the rollers and is partially recycled before discarding. The recycled city water from the rollers passes to a de-scumming tank where oil residues are removed before flowing into the sewer system outside the plant.

Samples were taken of the well and city waters, of the tile cooling water at the settling tank and as it empties into Soldier Creek, of Soldier Creek ~50 yds upstream and 100 yds downstream of the effluent, and of the roller cooling water at the de-scumming tank and after the tank, as it enters the sewer system.

Soldiers Creek is apparently an effluent waterway for several manufacturing plants. The contamination (resulting in a pH change of 0.5 units over a matter of several hours on 1 July and foaming on 2 July) was apparently not severe enough to markedly affect aquatic life, Soldiers Creek near the tile plant effluent being a breeding ground for small fish.

Little evidence of asbestos emission was observed, although all the samples taken on 2 July from the point at which the tile cooling water empties into Soldiers Creek did show asbestos levels of the order of 10^6 to 10^7 fpl.

Key to Sampling Points - Table Z-1

U1 Well water at tile cooling trough

U2 City water

D1 Tile cooling water at settling tank

D2 Soldiers creek 50 yards upstream of effluent

D3 Effluent - tile cooling water — as it empties into Soldiers Creek

D4 Roller cooling water from thickness to sewer system

D5 Roller cooling water at thickness

D6 Soldiers Creek 100 yds downstream from effluent (D3)

Armstrong Cork Company,
Kankakee, Illinois

TABLE Z - 1

See Legend - page 29

Code T2

	7/1/75					7/2/75									
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1	G	BDL(0.47)	-	1	0	G	BDL(0.66)	-	4	0					
	G(R)	BDL(0.52)	-	1	0										
U2	G	BDL(0.29)	-	2	0										
D1	G	BDL(0.63)	-	1	0	G	BDL(1.3)	-	9	0					
D2	G	BDL(0.66)	-	1	0	G	BDL(0.63)	-	1	0					
D3	I	BDL(0.51)	-	1	0	I	15(C)	2.4	4	19					
						G	5.7(C)	3	7	19					
						G(R)	30(C)	5.1	7	100					

Armstrong Cork Company,
Kankakee, Illinois, page two

TABLE Z - 1, con't

Code T2

	7/1/75					7/2/75									
Location	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted
D4	G	BDL(19)	-	342	0	G	BDL(9.4)	-	359	0					
D5	I	BDL(0.92)	-	120	0	I	BDL(6.3)	-	1093	0					
	I(R)	BDL(0.92)	-	120	0										
D6	G	BDL(0.79)	-	1	0										

Appendix AA

Raybestos-Manhattan, Stratford, CT Code V1

Raybestos-Manhattan is a major producer of friction products incorporating asbestos, such as brake shoes, clutches, gears etc. The plant is located just off Rte 1 and I-95 on the edge of the town of Stratford a few miles east of Bridgeport. The area all along these highways is highly industrialized.

R-M purchases its upstream water from the town of Stratford which in turn buys it from Bridgeport Hydraulic. They use about 2 million gallons per day for processing.

The downstream process waste water from the different units is combined and piped alternately to one or the other of two 'drop-out' ponds at the rear of the plant. The overflow water then passes to a second settling pond before the overflow effluent is fed to a third and final pond called the 'Lagoon". The Lagoon effluent is fed into the Housatonic River. The Lagoon is also fed with two other streams - one from an acid treating unit (acid neutralized before feeding to the Lagoon) and one from condenser cooling water and paper water spray washings. The asbestos sludge solids from the drop out ponds is hauled away to disposal grounds.

The plant was visited twice. The first visit occurred 6-8 August 1975, and the second visit was 20-21 October 1975. There were no apparent differences observed in the waste water handling on these two occasions.

The downstream process water was sampled at the point of entering the drop-out pond. The overflow water from the second settling pond was the next effluent to be sampled and the third and last one was the effluent from the Lagoon just before being fed to the Housatonic River.

The clarification system used at Raybestos Manhattan, Stratford, effects a reduction about 2 orders of magnitude in the asbestos content of the effluent. There remains, however, about 10^9 to 10^{10} fpl in the final effluent fed to the Housatonic River.

Key to Sampling Point - Table AA-1

U1	Stratford City water
D1	Process waste water to dropout pond
D2	Overflow from 2nd settling pond to Lagoon
D3	Effluent from Lagoon to Housatonic River

Raybestos-Manhattan,
Stratford, Connecticut

TABLE AA - 1

See Legend - page 29

Code V1

	8/6/75					8/7/75					8/8/75				
Location	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted
U1	G	BDL(0.30)	-	5	0	G	0.38(A)	0	6	1	G	5.7(C)	3	13	16
	G(R)	BDL(0.30)	-	5	0										
D1	I	110000(C)	40931	1768	43	I	2200(C)	807	2	30	G	50000(C)	11250	1940	40
							380(A)*	380	100	6	G	110000	49995	1528	44
											G(R)	99000	28740	79.03	62
D2	I	6100(C)	586	2	385	I	6000(C)	397	8	227	I	1300(C)	132	12	79
D3	I	1400(C)	258	6	103	I	1700(C)	132	14	129	I	970(C)	175	4	61

* Amphibole is high Fe-anthophyllite or low Fe cummingtonite type

Raybestos-Manhattan,
Stratford, Connecticut

TABLE AA - 2

See Legend - page 29

Code V1

	10/20/75					10/21/75									
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1	G	BDL(0.38)	-	9	0	G	BDL(0.25)	-	7	0					
D1	I	260000(C)	15860	6	82	I	71000(C)	15158	1086	89					
						I(R)	TNTC	$\gg 10^{11}$	1086						
D2	I	12000(C)	734	8	49	I	15000(C)	357	2	84					
D3	I	1600(C)	376	1748	51	I	8700(C)	355	38	49					

Appendix BB

Raybestos-Manhattan, North Charleston, SC Code V2

The Raybestos-Manhattan Company is one of the largest asbestos plants manufacturing asbestos textile products. The plant is situated just inland from an arm of the Cooper River in a heavily populated industrial zone of North Charleston, 1-1/2 miles south of the Army depot.

The upstream water for plant use comes from two sources. The major one is an artesian well on the property producing about 276,000 gallons per day. The second source is North Charleston city water.

There is extremely limited water/asbestos contact in the textile weaving and spinning steps. Water is used to wet the looms, amounting to no more than 500 gallons per month. Of this, about 2/3 is removed by evaporation. The remainder is sealed in drums and shipped for landfill burial. When the Novatex operation is on live it uses about 2500 gallons of water per month. Because of security we were not permitted in this building.

Downstream water used in rubber manufacture enters an open ditch and is piped underground for 500 ft to a transfer box. Aqueous waste from all other operations joins this stream but there is not access to it for sampling. The effluent emerges outside of Raybestos property, spilling from a pipe into an open trench just beyond railroad tracks. The stream passes under Virginia Avenue and through Texaco property into the Cooper River. The asbestos solid wastes are bagged in polyethylene and hauled away to burial as landfill.

The plant was visited on 7-9 April 1975 and again on 24-25 November 1975. The water usage and waste treatment was the same on both occasions.

The upstream water of the city was sampled from a faucet in the rubber laboratory and the well was sampled from a by-pass hose at the well site.

The downstream used cooling water was sampled as it was available at the location between Building 52 and the fresh water well. The process waste water from the Novatex operation was sampled inside of Building 52 by Raybestos personnel but we were able to observe the sampling at a nearby window. The total outfall or first effluent from the plant was sampled just beyond the property line and fence, east of the railroad tracks.

BB - con't.

Little or no asbestos fiber is emitted from this plant, the maximum level detected in the total outfall being 15 x 10^6 fpl on 8 August 1975.

Key to Sampling Points Table BB-1

U1 City water

U2 Artesian well water

D1 Cooling water

D2 Process water from sump-Novatex process - intermittent flow

D3 Total outfall

Raybestos-Manhattan,
North Charleston, North Carolina

TABLE BB - 1
See Legend - page 29

Code V2

	4/7/75					4/8/75					4/9/75				
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1						G	BDL(0.13)	-	13	0	G	BDL(0.13)	-	13	0
U2	G	BDL(0.13)	-	21	0	G	BDL(0.13)	-	15	0	G	BDL(0.13)	-	12	0
	G	BDL(0.13)	-	12	0	G(R)	BDL(0.13)	-	15	0					
						G	BDL(0.13)	-	14	0					
D1	I	BDL(0.13)	-	14	0	I	BDL(0.13)	-	15	0	I	BDL(0.13)	-	37	0
D2	G	BDL(0.21)	-	23	0	G	BDL(0.13)	-	33	0	G	BDL(0.13)	-	17	0
											G	BDL(0.13)	-	23	0
											G(R)	0.38(A)			
D3	I	BDL(1.3)	-	14	0	I	15(C)	26-32	15	19	I	BDL(1.6)	-	14	0

Raybestos-Manhattan,
North Charleston, North Carolina

TABLE BB - 2

See Legend - page 29

Code V2

	11/24/75					11/25/75									
Location	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted	Type	f.p.l.	>5µm	tss mg/l	fibers counted
U1	G	BDL(0.13)	-	na	0	G	BDL(0.13)	-	5	0					
U2	G	BDL(0.13)	-	8	0	G	BDL(0.13)	-	5	0					
D1	I	BDL(0.13)	-	8	0	I	2.3(C)	0.26	8	9					
D2	G	BDL(0.25)	-	1	0	G	1.5(C)	0.25	3	12					
						G(R)	BDL(0.13)	-	3	0					
D3	I	BDL(0.13)	-	7	0	I	6.8(C)	1.9	7	54					

Appendix CC

Raybestos-Manhattan, Marshville, NC

Code V3

The Raybestos-Manhattan plant at Marshville is a smaller manufacturing division of R-M producing asbestos textiles. It is located on the north side of Rte 74 just east of Marshville and about 15 miles southeast of Charlotte, North Carolina. It is a semi-rural area.

The plant obtains its upstream water supply from available city water. There are three sources of this water: (1) Monroe municipal water, (2) Lane Creek (Marshville's water plant) filter plant, and (3) 16-24" water main from the next county which parallels Rte 74.

Water is not normally used in process operations. Some asbestos could accidentally enter the sanitary sewer from locker room areas. All used water is discharged through the sanitary sewer to an open septic tank on the east side of the property. Vigorous aeration promotes rapid decomposition of wastes with very little odor. The overflow runs through a buried pipe to a ditch which borders the property to the north and which carries a small amount of untreated sewage effluent from the town of Marshville. Estimated outflow is on the order of 1500 gallons per day. Solid wastes are bagged in polyethylene containers and transferred to large metal dumpsters for land fill burial.

The upstream water was sampled from a by-pass hose adjacent to the septic tank.

The downstream water was sampled from the septic tank and the final effluent overflowing into the ditch was sampled at the point of entry into the ditch.

Key to Sampling point - Table CC-1

U1 City water

D1 Sample from within septic tank — all plant outflow enters tank

D2 Outfall from septic tank

Raybestos-Manhattan,
Marshville, North Carolina

TABLE CC - 1

See Legend - page 29

Code V3

	4/14/76					4/15/76									
Location	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted	Type	f.p.l.	>5μm	tss mg/l	fibers counted
U1	G	BDL(0.13)	-	6.5	0	G	88(C)	0*	7.2	35					
D1	G	BDL(3.1)	-	137	0	G	BDL(6.3)	-	280	0					
	G	BDL(2.1)	-	108	0	G	BDL(2.5)	-	121	0					
D2	I	BDL(1.6)	-	381	0	I	BDL(0.7)	-	108	0					
	I(R)	250(C)	19	82.5	40										

* 94.29% <2μm
74.29% <1μm